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Involving caregivers in self-management interventions for patients with heart failure or chronic obstructive pulmonary disease. A systematic review and meta-analysis

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Does involving caregivers in self-management interventions improve the health-related quality of life of patients with heart failure and chronic obstructive pulmonary disease patients? A systematic review and meta-analysis – Response to reviewers

Dear Reviewers,

Thank you for reviewing this research paper and for providing your helpful feedback. Please see below response to your comments.

Reviewers Comments	Authors Response	Revision to manuscript
Reviewer 1		
Did the authors consider including only patients with heart failure? What was the explicit rationale for including both types of patients? It seems that there are a number of other chronic conditions that would require similar self-management approaches, too, so It is just a little unclear as to why both HF and COPD were the focus.	(i)Rationale for choosing HF and COPD over other chronic conditions has been expanded on	See page 2. First paragraph under heading of Background. Lines 6-10 in this paragraph
Given the small number of COPD studies/participants, including HF studies only may have increased validity of the paper specific to HF management.	(ii) We completed a sensitivity analysis with and without COPD studies. The results of this has not changed our interpretation of the data. A sentence on this has been included in the results section	Figure 1 of online supplementary file is sensitivity analysis with and without COPD Narrative text - See page 7, paragraph under heading "Impact on patient HRQoL of self-management interventions involving caregivers". Lines 7-9 of this paragraph. See also page 8, first paragraph on the page. Lines 10-12 of this paragraph.
I recognize that QoL may similarly be affected, and self-management strategies are important for both, as noted in the paper. But are there other reasons?	(iii) A sentence on why HRQoL was chosen as the outcome measure of interest has been included	See page 3, paragraph 3, lines 5-7 of this paragraph.

The rationale for the matching process could be made clearer. The goal of matching is to achieve two groups that look very similar, with the exception of the main variable(s) of interest (i.e., involving caregivers vs. not involving caregivers). Why were the variables used for matching determined to be important? Why not other variables more specific to the participants and interventions applied?	(i)An online supplementary Table has now been included which visually demonstrates the sampling. Additionally a sentence has been added to further clarify the matched sampling strategy	Online supplementary Table 1a Page 4, paragraph two under heading "search outcome". Lines 3-9 of this paragraph
I have some reservations about the comparison of studies involving caregivers vs. not involving caregivers. I am not sure that it is advisable to try to make a comparison between interventions that involved caregivers and those that did not, for several reasons as noted below: While I definitely recognize the difficulty in matching studies (given many important potential variables to consider), I do have concerns about the variables the authors chose to use in the matching scheme. In reviewing Table 1 and the table summarizing the characteristics of all studies, it appears that the matched pairings are different in a number of ways. I am concerned with the fact that the patients enrolled in the matched studies are sometimes quite different, in terms of disease severity (e.g., NYHA class). Also, the sample sizes and length of follow-up/intervention are sometimes drastically different, and outcomes were measured using different instruments (even though standardized differences were	(i)We acknowledge this reservation of the reviewer – for pragmatic reasons, we needed to match studies on study level characteristics and we did based on those criteria that we thought would be most likely to confound the comparison of two groups of RCT. Given that the imperfect matching, through the paper we have further emphasised the indicative nature of our findings and that they need to be interpreted with caution.	Table 1 has been amended to reflect more detail of the characteristics of the matched studies. Additionally, page 10, paragraph 1 indicates interpreting the findings in the context of the number of limitations in the study

compared, which does account for some variation). As the authors point out in the discussion, a major limitation is that studies have not often explicitly documented the degree to which caregivers are involved in care. Certainly the "dose" of caregiver involvement could theoretically have a drastic effect on the actual effect size of the intervention outcome. I think there is a major potential for confounding in the studies that did not explicitly involve caregivers, too, as there is not a good way of knowing how much caregivers were actually involved in patients' care. Even though they may not have explicitly been a part of an intervention, there is a decent likelihood that caregivers would have participated in care to some degree. In short, it may be more helpful to suggest that the limitations in reporting on the part of the included studies and the potential confounders make comparing these two types of interventions impractical at this time. Perhaps the authors could note that while they had intended to compare the effect of interventions using and not using caregivers, an accurate comparison became too difficult, given the limitations in the current body of evidence.	(ii) We completely agree with the reviewer on this point and this is why one of our inclusion criteria is studies that "formally" included caregiver in the intervention process. We have expanded this point when discussing the limitations of the study. (iii) We agree with the reviewer on this point. The conclusion section has been amended to reflect this.	See page 10, paragraph 1 Page 10, paragraph 1 under heading "conclusion". Lines 8-11
In the introduction, the authors could add a citation or two supporting the notion that there is an increased reliance on caregivers for HF and COPD patients.	A sentence and citations in the introduction at the end of paragraph one has been included to reflect this point	Page 1, paragraph 1 under "Introduction" Updated references include the following: Kennedy, et al., 2017 Nakken, et al., 2015

While most of the headings appear to follow JAN requirements, there are some headings missing. See https://onlinelibrary.wiley.com/page/journal/13652648/homepage/systematic_review_or_other_type_of_review_paper.htm	This has been amended to reflect the headings as per JAN requirements	Throughout the paper
Per journal guidelines, the title "should begin with a descriptor that best describes the type of review, such as: 'systematic review:' . . . 'meta-analysis'"	Title has been amended to reflect this	
Reviewer 2		
The exhibition and presentation of the statistical aspects of the study are lacking so that the manuscript cannot be completely assessed in its current form. See the comments I outline below. The manuscript needs to be revised so that the statistical presentation is improved and a fuller description is given, before the statistical methods and data results can be further assessed.	We have added a new supplementary Table 1b – which outlines the sampling strategy The statistical methods section has been elaborated and use of standardised mean difference has been explained further	Supplementary Table 1b Page 5, paragraph 2 under heading "synthesis", lines 3-6 of this paragraph
Pages 27-73, Table 1: The test upon which each p-value is based should be stated in a footnote to the table. A p-value without associated statistical test cannot be interpreted. The authors should make sure to state the statistical test used associated with each stated p-value in this long table.	Online supplementary Table 1b is a summary of included studies and does not include statistical tests. There is a footnote at the end of this table providing further clarity on any acronyms Table 2 – Risk of Bias assessment. This does not include any statistical tests. Online supplementary Table 3 consists of vote counting. Statistical tests upon which these p-values are based are included at the end of each author/grouping	Online Supplementary Table 1b – Summary of all 26 studies Table 2 – Risk of Bias of caregiver included studies Online supplementary Table 2 – Risk of Bias of all 26 studies Online Supplementary Table 3 – Vote Counting
Reviewer 3		

Abstract Review methods: Be more descriptive regarding key matching criteria. Which HRQoL measure used Results: Include – age & gender for sample descriptions	Abstract has been amended to reflect these suggestions	Abstract, page 1
Introduction Suggest shortening or including in background section, as key issues of paper addressed more effectively in the background section Does the line 'Caregivers experienced positive outcomes for reducing burden, anxiety and depression when interventions were targeted at the caregiver' read correct? Is it patients or caregivers who benefitted? Considered adding more references – one paper referenced frequently	The introduction and background section has been shortened This sentence has been re-phrased, p. 2, paragraph 2 of Introduction section More references have been added to introduction and background section	Page 1 - 3 Page 2, paragraph 2 of "Introduction", line 3-4 of this paragraph Page 1 – 3 Updated references include: Caress, Luker, Chalmers, & Salmon, 2009 Jaasrsma, Cameron, Riegel & Stromberg, 2017 Mi et al. 2017 Gardiner et al. 2010 Bergs, 2002 Piamjariyukal, Smith, Werkowitch & Elyachar, 2012 Casaburi, 2018 Sagar, et al., 2015 Simpson, Young, Donahue, & Rocker, 2010 Wingham, et al., 2015
Background Consider shorter reference style.	The journal requires APA style referencing.	
Study selection		

Suggest adding details of studies to methods in abstract. Which HRQoL tools were compared?	I have included the HRQoL tools of caregiver included studies in the abstract	Abstract – Results: Patient reported measures included: Minnesota Living with Heart Failure questionnaire, St. George's respiratory questionnaire and Short-Form-36
Conclusion Suggest moving successful self-management description to background section. I would focus on shortening the results section mainly.	The conclusion section has been re-phrased We deleted the narrative text summarising the characteristics of included studies in the results section. Characteristics are now in a Table The remaining section of the results responds to each of the fours aims of the paper and we therefore would not wish to shorten this section and lose important findings	Page 10 and 11 Table 1 – Characteristics of included studies Results page 5-8
Reviewer 4		
Title: I find that we need the patients in the title. So it will be "…. In patients with heart failure and…"	Title has been amended to reflect this	
Page 3, line 20-22: "However, currently there is…" I don't understand this sentence.	This sentence has been removed	
Page 3, line 54: You don't describe many qualitative studies above.	Amended	Page 3, paragraph 3 under "Introduction" heading Updated qualitative references include: Bergs, 2002 Piamjariyukal, Smith, Werkowitch, & Elyachar, 2012 Simpson, et al., 2010 Wingham, et al., 2015
Page 3, line 58: please provide why QoL is important to patients and caregivers? QoL is	Amended	Page 3, paragraph 3 under heading "Introduction", lines 5-7 in this paragraph

just one outcome you could also have included others.		
Page 4, line 8: Please rephrase the last sentence: “If we are fully…”. The sentence is not clear.	This sentence has been re-written for clarity.	Page 4, paragraph 1
Your introduction and background are very long – please shorten those a little.	Background and introduction have been edited	Pages 1 - 3
Page 4, aims: Aim number 3 is not clear. I read it like this: You have to do a search on RCT’s not involving caregivers, but I cannot read out of the ‘study selection’ that you have searched on that. Please rephrase or do a section under ‘study selection’ where you describe this search.	Page 4, aim three has been reworded to clarify this point. Additionally, a sentence has been added to point 3 on p. 4	Page 3, paragraph 1 under Aims, line Lines 3-5 of this paragraph Page 4, Point 3 under heading “search outcome”
Page 4, line 54: Multifaceted intervention: Can you provide some examples of interventions (very short)?	The word multifaceted has been removed and an example of intervention components included.	Page 4, point 3
Page 5, line 35: vote counting approach: Please explain.	Amended, to provide more clarity on what is vote counting	Page 5, Paragraph 3 under heading “synthesis”, lines 3-6
Page 7, line 36-37: Please do not refer to your results “The two studies (Hasanpour-DEhkordi et al. 2016 & Srisuk et al. 2017)” before you have described the results for the meta-analyses for the reader.	Amended	Page 7, paragraph 1, lines 5-7 of this paragraph
Page 8, line 53: “Four studies..”. Why not meta-analyses?	This sentence has been rephrased to reflect why there was not a meta-analysis of four studies.	Page 8, Paragraph under heading “Impact on caregiver HRQoL of self-management interventions involving caregivers”, lines 1& 2 of this paragraph
Page 9. Please provide a short answer to all four aims in the beginning of the discussion.	Amended	Page 8, paragraph 1 under heading “Discussion”. Lines 1-10 of this paragraph
Page 9, line 14: You call it methodology in the aim – use the same wording.	This sentence has been amended to keep the terminology consistent.	Page 8, paragraph 1 under heading “Discussion”. Line 1

Page 9, line 55-57: Please also compare this result ("our finding of no gain in patient HRQoL,…") with qualitative research. What does patients and caregivers say about being involved?	This sentence has been amended to reflect the patient and caregiver voice	Page 9 paragraph 4, lines 8 – 16 of this paragraph.
General comment: Please add either in the introduction/background that not all caregivers are fit to be there for the patient. Research shows that some caregivers get sick themselves or are sick and therefore are no help for the patient.	Amended	Page 1, paragraph one under heading "Introduction", lines 10-14 References: Pearlin, Mullan, Semple, & Skaff, 1990 Wingham, et al., 2015 Wingham, Frost, & Britten, 2017 Simpson, Young, Donahue, & Rocker, 2010
All the meta-analysis do not have headlines the way it is uploaded in the system. Maybe it is the system, but please be aware.	This is the way it was uploaded in the system. The headlines for these meta-analyses are in the main text.	Headings have also been added to each Table.

ABSTRACT

Aim Quantify the impact of involving caregivers in self-management interventions on health-related quality of life (HRQoL) of patients with heart failure (HF) or chronic obstructive pulmonary disease (COPD).

Design Systematic review, meta-analysis.

Data sources Searched: Medline Ebsco, PsycINFO, CINAHL, Embase, Web of Science, The British Library and ProQuest.

Review Methods Randomised controlled trials involving caregivers in self-management interventions (≥2 components) compared to usual care for patients with HF or COPD. A matched sample based on publication year, geographic location, and inclusion of an exercise intervention of studies not involving caregivers were identified. Primary outcome of analysis was patient HRQoL.

Results 13 RCT's (1,701 participants: 1,439 HF; 262 COPD) involving caregivers (mean age 59; 58% female) were identified. Reported patient HRQoL measures included; Minnesota Living with Heart Failure questionnaire, St. George's respiratory questionnaire and Short-Form-36. Compared to usual care, there was similar magnitude in mean improvement in patient HRQoL with self-management interventions in trials involving caregivers (mean standardised mean difference (SMD): 0.23, 95% confidence interval: -0.15 to 0.61) compared to trials without caregivers (SMD: 0.27, 0.08 to 0.46).

Conclusion Within the methodological constraints of this study, our results indicate that involving caregivers in self-management interventions does not result in additional improvement in patient HRQoL in HF or COPD. However, involvement of caregivers in intervention delivery remains an important consideration and key area of research.

Impact Greater understanding and awareness is needed of the methodology of caregiver engagement in intervention development and delivery and its impact on patient outcomes.

Keywords Caregivers, heart failure, chronic obstructive pulmonary disease, self-management, interventions, meta-analysis, systematic review,

INTRODUCTION

Behaviour change and psychological coping theories frequently inform the development of psychosocial interventions. Such interventions are particularly relevant in the domain of self-management for individuals with chronic conditions; enabling individuals with long term conditions to live with and manage the signs and symptoms of their illness (Grady & Gough, 2014). As healthcare systems experience increasing financial pressures, the development of alternative strategies for the sustainability of the delivery of self-management programmes is needed (Rotheram-Borus, Ingram, Swendeman, & Lee, 2012). Patients are relying more on unpaid caregivers (families/friends) to support them in their self-management. (Carers Trust, 2015). Older caregivers compared with non-caregivers experience more depression, stress and poorer subjective well-being (Pinquart & Sörensen, 2003). Physical and mental health deterioration of the caregiver leads to disengagement from the caregiving role. This can be detrimental for both the patient and caregiver (Pearlin, Mullan, Semple, & Skaff, 1990). Caregivers have a variety of needs which may impede their ability to provide care for patients (Wingham, et al., 2015; Wingham, Frost, & Britten, 2017) creating worries about the future when they can no longer provide care (Simpson, Young, Donahue, & Rocker, 2010). Caregivers of HF and COPD patients are experiencing an increasing reliance to provide support (Kennedy, et al., 2017; Nakken, et

al., 2015). However, there is a gap in the knowledge base examining the impact of involving caregivers in the delivery of intervention on patient outcomes.

A meta-analysis of randomised controlled trials (RCTs) examining the benefits of family member involvement in psychosocial interventions demonstrated positive outcomes for patients on depression and mortality and positive outcomes for caregivers in reducing burden, anxiety and depression. However, the aggregate effect of these outcomes were small in magnitude (Martire, Lustig, Schulz, Miller, & Helgeson, 2004). Hartmann, Bäzner, Wild, Eisler and Herzog (2010) conducted a meta-analysis of family involvement in the treatment of chronic illness (cardiovascular disease and arthritis) interventions for physical conditions. They concluded, family involvement in interventions resulted in significantly better patient and family members' physical and mental health compared to standard care. However, research into patient-partner dyads in self-management interventions for chronic disease is limited (Bryant, et al., 2016) and findings are inconsistent, especially with regards to how caregivers should best be involved in delivery of such interventions. A mixed methods study examining the perception of rehabilitation one-year post stroke for patients and their caregivers emphasised that researchers should take a broader perspective and research the patient-partner dyad which can increase the understanding of the wider complex external factors in patient's rehabilitation (Ekstam, Johansson, Guidetti, Eriksson, & Ytterberg, 2015). In order to develop the efficacy of family involvement, research should focus on illness specific populations, interventions with long-term follow up, greater specificity on the extent of family member engagement and description of theoretical basis and selection of outcome measures (Caress, Luker, Chalmers, & Salmon, 2009; Martire, et al., 2004).

Conceptual underpinnings in family focused interventions for patients with heart failure (HF) are not explicit in HF and caregiver intervention development (Deek, et al., 2016). Similarly, Bryant and colleagues reported similar when examining intervention studies involving caregivers in chronic obstructive pulmonary disease (COPD) (Bryant, et al., 2016). They emphasise the methodology of caregiver involvement is poorly described and there is a greater need for theoretically based interventions in testing the effectiveness of interventions.

BACKGROUND

A diagnosis of HF or COPD is a life-changing event (Barnett, 2005; Jeon, Kraus, Jowsey, & Glasgow, 2010). Both are long term, life-limiting conditions; characterised by significant physical impact on one's life including breathlessness, fatigue, chest tightness, and reduced ability to exercise (Agusti, 2007; Britton, 2003; Ponikowski, et al., 2016). It is estimated at least 26 million people worldwide live with HF (Savarese & Lund, 2017) and 65 million people globally are living with moderate to severe COPD (Mathers & Loncar, 2006). Approximately 19% of patients with COPD are diagnosed with HF (Conrad, et al., 2017), whilst approximately 35% of patients with HF are diagnosed with COPD (Lainscak & Anker, 2015). Both conditions can be self-managed with medication and lifestyle adaptations. Researchers and policy makers are advocating rehabilitation interventions which combine HF and COPD (Man, et al., 2016). An exercise rehabilitation programme trialled with both HF and COPD patients demonstrated that combining an exercise programme for these conditions was effective (Evans, et al., 2010). Support has been identified as a key component for patients to be successful in their self-management (Dwarswaard, Bakker, van Staa, & Boeije, 2016).

Supporters of patients such as unpaid caregivers are important contributors to HF and COPD self-care (Bove, Zakrisson, Midtgaard, Lomborg, & Overgaard, 2016; Vellone, et al., 2015) and should be

included in the process when providing interventions for people with HF or COPD (Clark, et al., 2014; Gardiner, et al., 2010; Jaasrsma, Cameron, Riegel, & Stromberg, 2017; Mi, et al., 2017). The United Kingdom National Institute for Health and Care Excellence (NICE) clinical guidelines for HF (NG106) and COPD (NG115) advocate the inclusion of family members/caregivers in health care discussions and in rehabilitation. A Cochrane review of interventions supporting caregivers in the terminal phase of illness recommend further research to assess interventions on the health of caregivers (Candy, Jones, Drake, Leurent, & King, 2011).

Qualitative research has highlighted the needs and important contributions of HF and COPD caregivers to patient self-management (Bergs, 2002; Piamjariyukal, Smith, Werkowitch, & Elyachar, 2012; Simpson, et al., 2010; Wingham, et al., 2015). There is a paucity of quantitative evidence as to whether involving caregivers in self-management interventions positively impacts on HF or COPD patient's outcomes; particularly health related quality of life (HRQoL). HRQoL is important to measure due to the long term, enduring nature of these conditions. Engagement with both pulmonary and cardiac rehabilitation have demonstrated positive improvements in patient HRQoL (Casaburi, 2018; Sagar, et al., 2015). Existing evidence is conflicting regarding the success of the intervention and lacks clarity about the extent of the involvement of caregivers and the methodological rigour (Bryant et al., 2016; Buck et al., 2018; Evangelista, Strömberg, & Dionne-Odom, 2016). A review of self-management approaches for people with chronic conditions indicates that there is a gap in the literature with regard to caregivers and self-management interventions (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002). If we are to facilitate effective self-management interventions for patients with HF and COPD we need a greater understanding of the effects of caregivers with this population.

THE REVIEW

Aims

The aims of this systematic review and meta-analysis of RCTs that involve caregivers in the delivery of self-management interventions for patients with HF or COPD are to: (1) assess methodology used by researchers to involve caregivers; (2) quantify the impact on patient HRQoL; (3) compare the magnitude of impact on patient HRQoL of RCTs that do versus those that do not involve caregivers in the delivery of self-management interventions; and (4) examine the impact on the HRQoL of caregivers.

Design

This systematic review and meta-analysis was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses PRISMA statement (Moher, Liberati, Tetzlaff, & Altman, 2009). The protocol for this review was published on Prospero; international prospective register of systematic reviews. ID number CRD 42018090748.

Search methods

Our search strategy was designed in conjunction with experienced Information Specialists. Search terms included condition specific terms, i.e., "heart failure", and "chronic obstructive pulmonary disease" and intervention related terms "self-management" and "education" (see online supplementary file for a full list of search terms). Databases searched included: Medline Ebsco, PsycINFO, CINAHL Plus with Full Text, Embase, Web of Science, The British Library and ProQuest. Grey literature was identified using Global Dissertations and Theses and Applied Sciences Index and hand searches and citation checking of included references. To ensure the contemporary nature of the

evidence considered, the search time frame was January 1990 to 30th March 2018. A single researcher (MN) initially screened titles and abstracts. Selection of full papers was performed by two researchers (MN and RST) and cross checked with the eligibility criteria.

Search outcome

Studies were included if they met the following criteria:

(1) Study design: RCTs (including individual or cluster designs).
(2) Population adults (≥ 18 years) with HF or COPD.
(3) Intervention: Self-management intervention programmes which were comprised of two or more intervention components (e.g. exercise, education, support and psychotherapeutic elements). The self-management interventions either formally included caregivers in the delivery of the intervention compared to usual care or did not involve caregivers in the delivery of the intervention compared to usual care. We classified formal inclusion of caregivers as; caregivers being explicitly included as participants in the intervention.
(4) Outcomes: Patient and caregiver HRQoL.

We excluded: (1) studies in long term residential care setting; (2) studies where caregivers were not explicitly part of the intervention delivery.

In order to compare HRQoL outcomes of studies involving caregivers in intervention delivery and studies that did not involve caregivers in intervention delivery we employed a quasi-randomised sampling strategy. A matching strategy was undertaken to minimise potential differences between studies i.e. comparison of intervention studies involving patients only versus intervention studies involving both patient and caregiver. Studies not involving caregivers were first listed in alphabetical order and were then matched with the caregiver studies. Four study level criteria; which were consistently reported across all trials were pragmatically chosen for matching: (1) patient diagnosis (HF or COPD), (2) geographical location (Europe, North America, or other), (3) year of publication (pre or post 2000), and (4) inclusion of exercise as a key intervention component.

Quality Appraisal

The Cochrane Risk of Bias Tool (Higgins, Savović, Page, & Sterne, 2018) was used to determine the methodological quality of included studies. Study authors were contacted by MN if any required data was missing for meta-analysis. Data extraction and risk of bias assessment were initially conducted by one reviewer (MN) and revised by a second reviewer (RST). Any disagreements were resolved through discussion and reaching consensus.

Data Abstraction

A standardised data extraction form was used to extract details on the study, population, intervention, HRQoL outcome measures at all time points and the author's conclusion. Studies with multiple publications were all reviewed and data was extracted into a single data extraction form. A bespoke data extraction tool was developed guided by the Medical Research Council guidelines for complex interventions (Craig, et al., 2006) and the TiDier checklist (Hoffman, et al., 2014).

Synthesis

Results of this systematic review are presented descriptively in the form of detailed tabular summaries and a quantitative synthesis of patient HRQoL outcomes using both meta-analysis and a vote counting approach.

All relevant data available for included studies were pooled for statistical meta-analysis using Review Manager 5.3 (Rev Man V.5.3, The Cochrane Collaboration). Given the variation in HRQoL outcomes reported across studies, between group outcomes were expressed across studies as standardised mean differences (SMD). That is, the results of studies are standardized to the same scale in order to combine them. The weight of the intervention effect is expressed comparatively to the variability identified in the study (Higgins & Green, 2011). Studies were pooled using random effects meta-analysis due to the clinical heterogeneity of included studies. Meta-analysis was conducted by pooling total HRQoL score at the latest point of follow up. In studies reporting more than one HRQoL measure, the primary HRQoL measure was used (or if primacy was not stated, the outcome measure described first in the methods section of the study was utilised). We undertook a sensitivity analysis excluding COPD studies. Data was presented descriptively using tables to summarise and synthesise the findings. Meta-analysis results were reported as means and 95% confidence intervals (CIs). Missing data was imputed when possible using STATA V.15.

Given that all studies did not report HRQoL data that could be included in meta-analysis we also undertook a vote counting assessment of HRQoL outcomes across all included studies. That is; quantitatively categorising all studies according to existence of a statistically significant ($P \leq 0.05$) effect on HRQoL between intervention and control groups (Higgins & Green, 2011). The advantage of the vote counting method (over meta-analysis) is that it allows inclusion of studies irrespective of their method of quantitative reporting of outcomes. As a sensitivity analysis, we compared the conclusions of vote-counting to our meta-analysis.

RESULTS

Study selection process

Following removal of duplicates the search strategy yielded a total of 16,183 title and abstracts. Of these, 602 full papers were reviewed. This resulted in 13 studies involving caregivers for synthesis. Therefore, 13 matched studies not including caregivers were retained for comparative meta-analysis. The study selection process is summarised in a PRISMA Flow diagram shown in Figure 1.

Three pairs of studies did not meet all four criteria for this sampling strategy, and were instead matched on diagnosis, year, exercise as a key element of the intervention and HRQoL. The matched sampling strategy can be viewed online.

Figure 1 – PRISMA

Characteristics of included caregiver studies

We synthesised thirteen studies (14 publications) which involved caregivers in the delivery of the intervention (Ågren, Berg, Svedjeholm, & Strömberg, 2015; Ågren, Evangelista, Hjelm, & Strömberg, 2012; Azad, Molnar, & Byszewski, 2008; Cline, Israelsson, Willenheimer, Broms, & Erhardt, 1998; Deek et al., 2017; Farquhar, et al., 2016; Hasnapour-Dehkordi, Kahledi-Far, Khaledi-Far, & Salehi-Tali, 2016; Jonsdottir, et al., 2015; Liljeroos, Ågren, Jaarsma, Årestedt, & Strömberg, 2015; Mårtensson, Strömberg, Dahlström, Karlsson, & Fridlund, 2005; Marques, et al., 2015; Naylor, et al., 2004; Srisuk, Cameron, Ski, & Thompson, 2017; Witham, et al., 2012). A summary of the characteristics of all 26

studies is shown in Table 1. All detailed summary of all included studies can be accessed via an online supplementary file.

Table 1 - Characteristics of studies

Risk of Bias

A summary of risk of bias assessment in caregiver included studies is shown in Table 2. Studies were of mixed quality and often poorly reported. The methodological issues most often classified as high risk were: blinding of participants/personnel (n = 12) and incomplete reporting of data (n = 6). The majority of studies were judged to be at low risk for random sequence generation (n = 12) and baseline balance (n=13). Details of risk of bias assessment for all 26 studies can be accessed via an online supplementary file.

Table 2 – Risk of Bias Assessment

Methodology of caregiver involvement

Table 3 describes the intervention components of these studies. The predominant method of caregiver involvement was face to face (10/13 studies; 77%) with health professional and the person they were providing care for (Ågren, et al., 2015; Ågren, et al., 2012; Azad, et al., 2008; Deek, et al., 2017; Hasnapour-Dehkordi, et al., 2015; Farquhar, et al., 2016; Srisuk, et al., 2017; Mårtensson, et al., 2005; Cline, et al., 1998). Four studies (31%) utilised group sessions as a component of the intervention (Azad, et al., 2008; Marques, et al., 2015; Jonsdottir, et al., 2015; Witham, et al., 2012). One study (8%) specifically reported that caregivers were invited to share their experiences (Ågren, et al., 2015). Addressing family or caregiver needs was referred to as a component of the intervention in seven (54%) studies (Ågren, et al., 2015; Ågren, et al., 2012; Naylor, et al., 2004; Marques, et al., 2015; Azad, et al., 2008; Witham, et al., 2012; Farquhar, et al., 2016). In two (15%) studies caregivers only, participated in a part of the intervention; an educational section (Witham, et al., 2012); and counselling sessions and educational session on understanding heart failure (Azad, et al., 2008). Three (23%) studies described the theoretical underpinnings in the intervention development (Ågren, et al., 2012; Deek, et al., 2017; Srisuk, et al., 2017):

1) Concept model based on Stuifbergen and Pender's model of health promotion and Bandura's self-efficacy theory (Agren, et al., 2012).
2) Behaviour change in adults, Behaviour change wheel. Behaviour change interventions. Middle range theory of self-care of chronic illness. Orem's self-care theory. The situation specific theory of heart failure self-care (Deek, et al., 2017).
3) Adult learning theory and teach back method (Srisuk, et al., 2017).

The remainder reported their intervention development in the following formats; best practice clinical guidelines (Mårtensson, et al., 2005; Farquhar, et al., 2016; Naylor, et al., 2004), conducting a literature review (Marques, et al., 2015), focus group involving family members (Hasanpour-Dekhordi, et al., 2016), previous use of the intervention (Witham, et al., 2012; Jonsdottir, et al., 2015) and previous qualitative research (Ågren, et al., 2015). The two studies which demonstrated the greatest gains in patient HRQoL compared to usual care were both face to face and multidisciplinary in their delivery with multi-component hard copy materials provided for patients (Hasanpour-Dehkordi, et al., 2016; Srisuk, et al., 2017). Both studies were conducted in middle income countries (Iran and Thailand)

respectively. Intervention development was based on theory; adult learning theory (Srisuk, et al., 2017) or informed by focus groups involving patient and caregivers (Hasanpour-Dehkordi, et al., 2016).

Table 3 – Intervention components of studies involving caregivers

Meta-analysis

Impact on patient HRQoL of self-management interventions involving caregivers

(1) Meta-analysis

Seven studies that involved caregivers provided total HRQoL score that could be included in a meta-analysis. Outcome measures used included both disease specific measures (i.e. Minnesota Living with Heart Failure questionnaire, St. George's respiratory questionnaire) and generic measures (Short-Form-36). Whilst there was evidence of higher patient HRQoL with intervention compared to usual care control (mean standardised mean difference (SMD): 0.23, 95% CI: -0.15 to 0.61), this failed to reach statistical significance (P = 0.24). There was evidence of a high level of statistical heterogeneity seen across studies (I^2 = 83%). A sensitivity analysis was conducted to examine caregiver included studies of HF patients only. This did not alter the interpretation of the results (mean standardised mean difference (SMD): 0.34, 95% CI: -0.16 to 0.85, P = 0.19, I^2 = 88%). This sensitivity analysis can be viewed online.

Figure 2 – Forest plot of caregiver included studies

Another sensitivity analysis was conducted which included studies reporting SF-36 physical and mental component subscales (PCS and MCS) (Ågren, et al., 2015; Deek, et al., 2017). Results remained consistent with the primary meta-analysis i.e. PCS inclusion: SMD: 0.25, 95% CI: -.0.10 to 0.61 (P = 0.16) (see online supplementary file) and MCS inclusion: SMD: 0.19, 95% CI: -0.10 to 0.49 (P = 0.20) (see online supplementary file). Again a high level of statistical heterogeneity was seen (both I^2 = 79%)

(2) Vote counting

A number of included studies reported >1 HRQoL domains giving a total of 136 HRQoL intervention vs controls. The results of vote counting were consistent with the meta-analysis in that only 18 (13%) intervention vs control comparisons showed statistical superiority (P<0.05) of the intervention compared to control.

Impact on HRQoL of self-management interventions not involving caregivers

(1) Meta-Analysis

We were able to include HRQoL data in a meta-analysis from 12 studies that did not involve caregivers in intervention delivery. In addition to the outcome measures reported in the previous meta-analysis; patient only studies also utilised the Kansas City Cardiomyopathy questionnaire, Clinical COPD questionnaire, SF-12, COPD Assessment Tool, Chronic Respiratory questionnaire and a Chronic Heart Failure questionnaire. Similar to patient and caregiver studies, excluding the SF-12, all outcomes measures for HRQoL are illness specific. Details of outcome measures are included in the summary of studies table online. The pooled patient HRQoL studies that included caregivers and studies that did

not were not significantly different (P= 0.84). Statistical heterogeneity was evident across both groups of studies (caregivers not involved; I^2 = 62% and caregiver included; I^2 = 83%). A sensitivity analysis removing COPD studies did not yield any different interpretation of results (P=0.93) Statistical heterogeneity across both groups (caregivers not involved; I^2 =71% and caregiver included; I^2 = 88%). Figure demonstrating sensitivity analysis can be viewed online.

Figure 3 – Forest plot comparing caregiver included studies with studies not involving caregivers

2) Vote Counting

A number of included studies reported >1 HRQoL domains giving a total of 239 HRQoL intervention vs controls. The results of vote counting were consistent with the meta-analysis in that only seven (7%) intervention vs control comparisons showed statistical superiority (P<0.05) compared to control (see online supplementary file).

Impact on caregiver HRQoL of self-management interventions involving caregivers

Due to the small sample size (n=4) reporting caregiver HRQoL in the included studies we did not undertake a meta-analysis and instead report these findings narratively. These four studies reported caregiver HRQoL outcomes (Ågren, et al., 2015, Ågren, et al., 2012; Liljeroos, et al., 2015; Srisuk, et al., 2017) using either the SF-36 or SF-12. Partners at 12 months in the psychoeducational intervention group improved their HRQoL compared to control (Ågren, et al., 2015). The study with longest follow up; 24 months, which recorded caregiver outcomes (Liljeroos, et al., 2015) demonstrated that caregiver HRQoL scores were significantly reduced (indicating a deterioration) in physical functioning on the SF-36. A family-based education demonstrated no difference in caregiver HRQoL between intervention and control group after six months (Srisuk, et al., 2017). Caregiver HRQoL in this study was reported to be consistent with the general population. (Srisuk, et al., 2017).

DISCUSSION

In accord with aims of this study, our review demonstrated two key findings. First, the methodology of caregiver involvement in intervention delivery was poorly reported. Second, there was no evidence from meta-analysis of a gain in patient HRQoL in RCTs that involved caregivers in the delivery of self-management interventions for patients with HF and COPD. The pooled patient HRQoL in RCTs that included caregivers in intervention delivery compared with studies that did not include caregivers were not significantly different (P=0.84). However, these finding need to be interpreted cautiously in the context of the methodological constraints of this study i.e. small number of included trials; imperfect matching between the two groups of trials; and high levels of statistical heterogeneity within both groups of trials. We were not able to assess the impact of caregiver involvement in intervention delivery on caregiver HRQoL due to lack of data.

Our findings are consistent with Pillemer, Suitor and Wethington (2003), who concluded that interventions utilising broader theoretical evidence may have more successful outcomes and reduce the lack of clarity and inconsistent findings which occur in caregiver studies. They posit that intervention development should be aimed at dyads. Cho (2007) proposes a theoretical framework for the effect of caregivers on elderly care recipients. It concludes; the type of caregiver, nature of the relationship, whether caregiving is direct or indirect and the internal processes of the care recipient

(psychological, behavioural and physiological) are caregiver influences on elderly care recipient outcomes and should be considered in intervention development and delivery.

One example of comprehensive intervention development is the approach used in developing an evidence based self-management intervention for HF patients and their caregivers (Greaves, et al., 2016). Utilising intervention mapping and eliciting and synthesising information from a multitude of sources they produced the rehabilitation enablement in chronic heart failure intervention (REACH-HF). This intervention demonstrated a clinically significant improvement in disease specific HRQoL. (Dalal, et al., 2018).

The depth of caregiver engagement in studies is difficult to determine as the extent of caregiver involvement is not explicitly documented. The high level of heterogeneity across caregiver studies may reflect this. We know from research that caregivers have a complex array of needs when engaging in the role (Dionne-Odom, et al., 2017; Noonan, Wingham, & Taylor, 2018). The effects of involving caregivers in interventions are variable (Sörensen, Pinquart, & Duberstein, 2002). The type of intervention, the method of study and the caregiving context all need to be heeded when involving caregivers (Söresnsen, et al., 2002). Each of the studies included in this meta-analysis adhered to some but not all of these concepts. The two studies which demonstrated statistically significant outcomes in favour of caregiver involvement (Hasanpour-Dekhordi, et al., 2016; Srisuk, et al., 2017) are worth reflecting on when considering development of caregiver involved interventions. Both studies were conducted in middle income countries. Their utilisation of evidence in intervention development, multidisciplinary delivery and provision of multi-component materials to participants are all in line with the Medical Research Council guidelines for developing and evaluating complex interventions (Craig, et al., 2006). It is important to note that we cannot make assumptions due to the small number of studies.

Our indicative finding of no gain in patient HRQoL from caregiver involvement in intervention delivery is in contrast to the conclusions from systematic reviews which suggest caregivers should be involved intervention processes (Bryant, et al., 2016; Dionne-Odom, et al., 2017; McIlfatrick, et al., 2017; Noonan, et al., 2018). Zariksson and colleagues conducted interviews with caregivers of COPD patients two years after they participated in a one-off education session of a COPD self-management programme. Caregivers reported feelings of fear due to increased knowledge about the condition. They also reported feeling empowered, an increased sense of togetherness with the patient and greater understanding of the condition. The conclusion from this intervention is that inviting caregiver to one education session is not enough and that further strategies such as psycho-education are necessary (Zariksson, Theander, & Anderzén-Carlsson, 2013). Interviews from family members who were part of a palliative care intervention for HF patients revealed how participating in the intervention resulted in feeling less worried and less responsibility as the care was shared between them and the healthcare professionals. Caregivers did identify a lack of support for their own needs, concluding that interventions should also be targeted towards supporting caregivers, to maintain them in their caregiving role (Alvariza, Årestedt, Boman, & Brännström, 2018).

Interpreting these findings should be considered in the context of a number of limitations of this study. First, this review identified only a small number of studies that included both caregivers in the delivery of self-management intervention. Of these, only seven reported their outcomes so they could be included for meta-analysis. Nissen, Madsen and Zwisler (2008) reported similar findings. Their literature review examined health interventions targeted at relatives of HF patients. They report health service intervention studies examining caregiver and patient are few in quantity and poor in quality. As a result they were unable to determine the overall evidence for the effectiveness of the conducted interventions. Similar conclusions were reached from a review of research output in COPD

focusing on burden and unmet need of caregivers (Mansfield, et al., 2016). They emphasised the need for more rigorous research in this area. Second, formally involving caregivers in interventions for patients with HF and COPD is a developing area of practice and process of caregiver engagement remains poorly reported. Descriptions of what constituted caregiver involvement in interventions differed between studies. It is important to acknowledge that caregivers may have been involved to some degree even when not specifically reported. However, a key aim of this review was examining the impact of explicitly involving caregivers in the intervention process. Therefore, this does make a direct comparison of studies involving versus not involving caregivers difficult. A previous systematic review examining caregiver involvement in COPD patients (Cruz, et al., 2017) was also limited by the lack of clarity on how caregivers were involved in interventions. Third, the matching criteria has some potential limitations. While we set out to compare treatment effect it was difficult due to the volume of patient only studies and the lack of caregiver included studies. We matched on four variables (Diagnosis, publication year, geographic location and exercise as a component of the intervention), however other variables could have been used for matching (e.g. severity of the illness, sample size and intervention duration). However, the four selected criteria were deemed to be free from bias and the most homogenous across studies facilitating a quasi-randomised sampling strategy. Fourth, this review examined only patient outcomes in terms of HRQoL. It did not examine patient hospitalisations or mortality or caregiver burden which may have produced different findings. However, given the lack of evidence identified by this review, we believe it is unlikely that RCTs reporting such outcomes are available. Much of the literature in this area of caregiver involvement in HF and COPD is commonly qualitative in its approach and RCT's are limited. As identified by Hartman, et al. (2010) and Srisuk, Cameron, Ski and Thompson (2016), there is a greater need for RCT's which examine patient and caregiver outcomes to determine the value of dyadic interventions in chronic illness.

CONCLUSION

This review demonstrates that RCT's examining the impact of caregivers in interventions are limited. Additionally, those studies which have examined caregiver involvement are limited in; describing the methodology of caregiver involvement, recording of caregiver outcomes and their reporting of theoretical underpinnings of the intervention development. Self-management interventions are complex and should not be taken as a one size fits all approach (Warsi, et al., 2004). A key factor necessary in self-management is to facilitate the development of social support (Rotherham-Borus, et al., 2012). This review set out to compare the impact of involving caregivers in interventions for those with HF and COPD versus interventions not involving caregivers. Within the methodological constraints of this study (i.e. relatively small number of included RCTs, imperfect matching of RCTs, and high levels of statistical heterogeneity), our results provide indicative evidence that involving caregivers in self-management interventions do not appear to further improve the HRQoL of HF or COPD patients. Greater reporting of the methodology of caregiver involvement and understanding the complexity of self-management interventions and the intricacy of the patient caregiver dyad will facilitate the development of more robust evidence-based interventions for patients and caregivers in HF or COPD interventions. This review demonstrates the need for further empirical research involving caregivers in interventions with this population and documenting the outcomes of patients and caregiver HRQoL.

Implications for clinical practice

This systematic review demonstrates that self-management interventions can have positive impact on the HRQoL of HF and COPD patients. Clinicians must reflect upon how they are currently involving caregivers in interventions and whether that engagement is meaningful. Meaningful engagement of caregivers may yield greater intervention success.

Implications for future research

This systematic review highlights the need for further research into the involvement of caregivers in the design and development of self-management interventions for chronic illness. When reporting studies involving caregivers, a greater depth of information needs to be provided on what constitutes caregiver involvement and what caregiver outcomes are in addition to patient outcomes. Future studies need to be more robust with greater emphasis on reporting data and managing blinding of participants and personnel. Addressing these issues may assist to produce a taxonomy of the type of caregiver involvement in self-management interventions for HF and COPD patients.

ANONYMISED CONFLICT OF INTEREST STATEMENT

No conflict of interest

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Witham, M. D., Fulton, R. L., Greig, C. A., Johnston, D. W., Lang, C. C., van der Pol, M., ... & McMurdo, M. E. (2012). Efficacy and cost of an exercise program for functionally impaired older patients with heart failure: a randomized controlled trial. *Circulation: Heart Failure*, *5*(2), 209-216.

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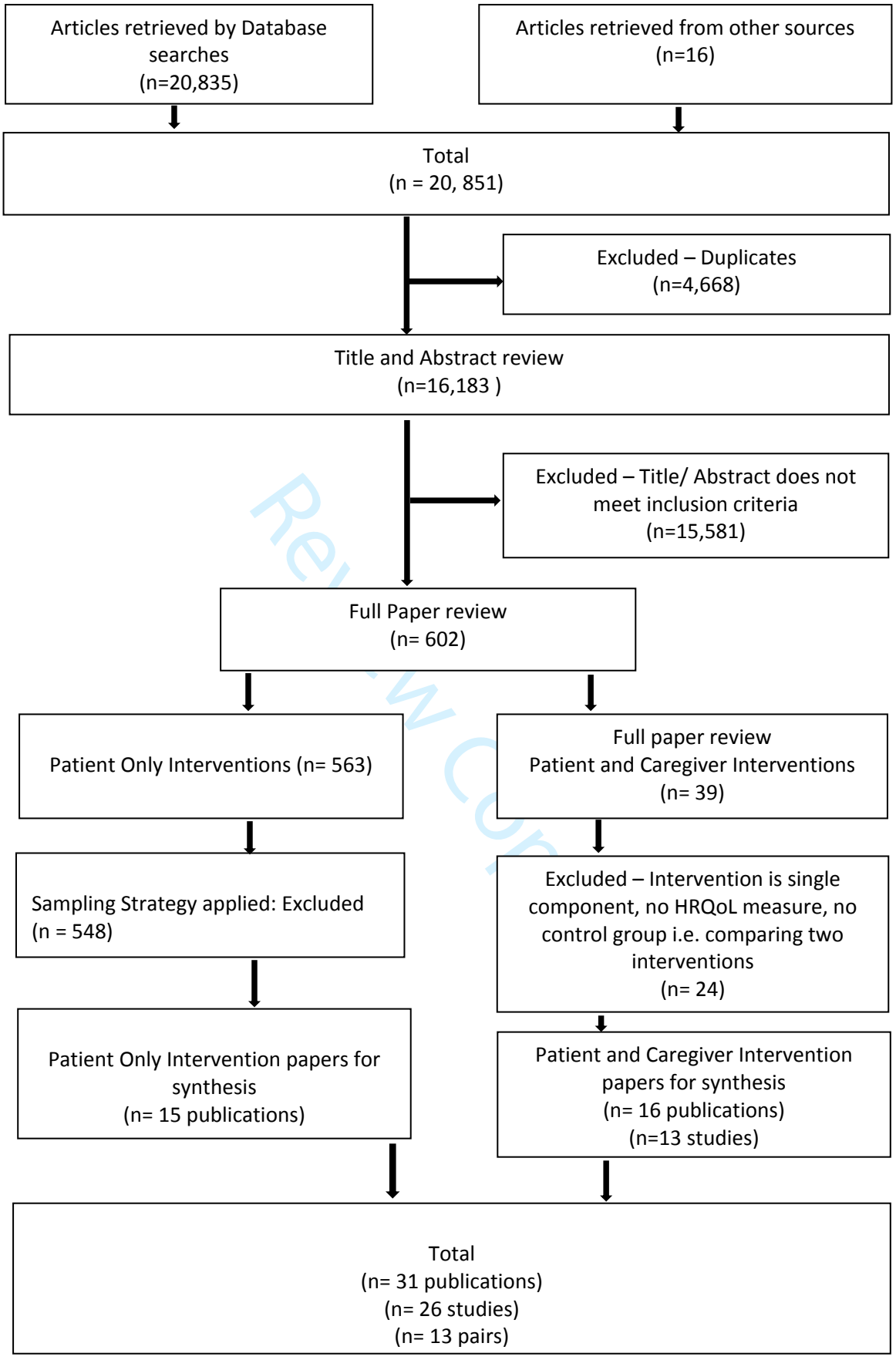

Articles retrieved by Database searches (n=20,835)
Articles retrieved from other sources (n=16)
Total (n = 20, 851)
Excluded – Duplicates (n=4,668)
Title and Abstract review (n=16,183)
Excluded – Title/ Abstract does not meet inclusion criteria (n=15,581)
Full Paper review (n= 602)
Patient Only Interventions (n= 563)
Full paper review Patient and Caregiver Interventions (n= 39)
Sampling Strategy applied: Excluded (n = 548)
Excluded – Intervention is single component, no HRQoL measure, no control group i.e. comparing two interventions (n= 24)
Patient Only Intervention papers for synthesis (n= 15 publications)
Patient and Caregiver Intervention papers for synthesis (n= 16 publications) (n=13 studies)
Total (n= 31 publications) (n= 26 studies) (n= 13 pairs)

Table 1 Characteristics of all studies

	Patient only studies N = 13		**Patient & Caregiver studies N = 13**		
Study Characteristics					
Publication Year					
1990 - 2000	1		1		
2000 - 2018	12		12		
Study Location					
Europe	6		8		
North America	4		2		
Other	3		3		
Sample size	**Total**	3,407	**Total**	1,701	
	Intervention	1,716	**Intervention**	840	
	Control	1,691	**Control**	861	
Single centre	5		6		
Duration of follow up	3 months – 4 years		One month – One year		
Population Characteristics					
Diagnosis					
Heart Failure	10		10		
COPD	3		3		
Age Mean					
Patient	**Intervention**	68.4	**Intervention**	70.4	
	Control	68.5	**Control**	70.1	
Caregiver (n= 5)	**Intervention**	n/a	**Intervention**	59.2	
	Control	n/a	**Control**	59.2	
Sex					
Patients – Female, n= 12*	1,220 (36%)		*682 (50%)		
Caregiver – Female, n=4	n/a		166 (58%)		
Intervention characteristics					
Exercise as a primary component	3		3		
Duration of intervention	One week – 16 months		One week – 52 weeks		
Frequency of intervention	Weekly – 6 monthly		Bi-weekly – 8 monthly		
Length of intervention	5 minutes – 2 hours		15 minutes – 2 hours		
Not reported	2		2		
Setting					
Home Based	3		1		
Clinic Based	4		5		
Combination of home and clinic based	6		5		
Not reported	0		2		
Risk of bias					
Random sequence generation	**High**	0	**High**	0	
	Unclear	3	**Unclear**	1	
	Low	10	**Low**	12	
Allocation Concealment	**High**	0	**High**	0	

	Unclear	5	**Unclear**	6	
	Low	8	**Low**	7	
Blinding of participants/personnel	**High**	11	**High**	12	
	Unclear	2	**Unclear**	1	
	Low	0	**Low**	0	
Blinding of outcome assessment	**High**	3	**High**	0	
	Unclear	4	**Unclear**	3	
	Low	6	**Low**	10	
Incomplete data reporting	**High**	5	**High**	6	
	Unclear	2	**Unclear**	5	
	Low	6	**Low**	2	
Selective reporting	**High**	1	**High**	2	
	Unclear	3	**Unclear**	2	
	Low	9	**Low**	9	
Groups balanced at baseline	**High**	0	**High**	0	
	Unclear	0	**Unclear**	0	
	Low	13	**Low**	13	
Did groups receive the same treatment	**High**	2	**High**	0	
	Unclear	1	**Unclear**	2	
	Low	10	**Low**	11	

Table 2 Risk of Bias Assessment

Author	Random Sequence generation	Allocation concealment	Blinding of participants/ personnel	Blinding of outcome assessment	Incomplete data reporting	Selective reporting	Groups balanced at baseline	Did groups receive same treatment
Agren 2015	Low Risk	Unclear Risk	High Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk
+Agren 2012 +Liljeroos 2017	Low Risk	Unclear Risk	High Risk	Unclear Risk	High Risk	Low Risk	Low Risk	Low Risk
Azad 2008	Low Risk	Low Risk	High Risk	Low Risk	Unclear Risk	Low Risk	Low Risk	Low Risk
Cline 1998	Low Risk	Unclear Risk	High Risk	Low Risk	Unclear Risk	Low Risk	Low Risk	Low Risk
Deek 2017	Low Risk	Low Risk	High Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk
Hasanpour 2016	Unclear Risk	Unclear Risk	High Risk	Unclear Risk	Low Risk	Low Risk	Low Risk	Unclear Risk
Jonsdottir 2015	Low Risk	Unclear Risk	High Risk	Low Risk	Low Risk	Unclear Risk	Low Risk	Low Risk
Marques 2015	Low Risk	Low Risk	Unclear Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk

Author	Random Sequence generation	Allocation concealment	Blinding of participants/ personnel	Blinding of outcome assessment	Incomplete data reporting	Selective reporting	Groups balanced at baseline	Did groups receive same treatment
Naylor 2004	Low Risk	Low Risk	High Risk	Low Risk	High Risk	Low Risk	Low Risk	Unclear Risk
Farquhar 2016	Low Risk	Low Risk	High Risk	Low Risk	Low Risk	High Risk	Low Risk	Low Risk
Srisuk 2017	Low Risk	Low Risk	High Risk	Low Risk	Low Risk	Unclear Risk	Low Risk	Low Risk
Mårtensson 2005	Low Risk	Unclear Risk	High Risk	Unclear Risk	High Risk	High Risk	Low Risk	Low Risk
Witham 2012	Low Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk	Low Risk	Low Risk

Table 3 Intervention Components

First Author Year	Theory	Material used	Delivered by	Mode of Delivery	Setting	Tailoring of intervention
Agren 2015	n/s	Dialogue guides Content of conversation Summarised and written	Multidisciplinary	1:1 Telephone	Outpatient clinic	n/s
Agren+ 2012	Stuifbergen et al. concept model based on Pender's model of health promotion and Bandura's self-efficacy theory	Computer & CD ROM Written teaching materials	Nursing	1:1 Computer	Clinic Home	n/s
Azad 2008	n/s	"Partners in Care" teaching tool	Multidisciplinary	1:1 & Group	Clinic	n/s
Cline 1998	n/s	Dosett (pill) box Guidelines for HF self-mgt. Patient diary Video presentation	Nursing	1:1	Hospital Home	Changes were made if clinically indicated
Deek 2017	Behaviour change in adults (Spring et al) Behvaiour change wheel (Michie et al) Behaviour change interventions (Noar et al) Middle range theory of self-care of chronic illness (Riegel) Orem's self-care theory (Orem). The situation specific theory of heart failure self-care (Riegel & Dickson)	Digital weighing scale Medication box Calibrated bottle Diary Bag with intervention logo	n/s	1:1	Hospital	n/s

First Author Year	Intervention Development Theoretical foundation	Material used	Delivered by	Mode of Delivery	Setting	Tailoring of intervention
Farquhar 2016	Medical Research Council guidelines on development and evaluation of complex interventions	Mindfulness CD	Multidisciplinary	1:1 Telephone Home	Clinic	n/s
Hasanpour-Dehkordi 2016	Family training developed from Focus groups	Training material	n/s	n/s	n/s	Patients were taken to health centre /physician if required
Jonsdottir 2015	Partnership was the basis of intervention	Presentations Written material	Nursing	1:1 Telephone Group	n/s	n/s
Liljeroos+ 2015/2017	Health promotion model (Stuifbergen et al)	Educational booklet Computer	Nursing	1:1	Clinic Home	n/s
Mårtensson 2005	n/s	CD-ROM Primary Health Care Physician	Nursing	1:1 Telephone	Home	n/s
Marques 2015	Developed based on a literature review	Role playing Gym access Home tasks	Multidisciplinary	1:1 Group	Primary Care Centre	n/s
Naylor 2004	American Heart Association guidelines	Audiotape Videocassette Written summary of goal progression	Nursing	1:1 Telephone (if required)	Home Hospital (if patient hospitalised during intervention)	n/s

First Author Year	Theory	Material used	Delivered by	Mode of Delivery	Setting	Tailoring of intervention
Srisuk 2017	Adult learning theory Teach back method	Heart Failure Manual DVD	Nursing	1:1 Telephone	Clinic Home	n/s
Witham 2012	n/s	Diary logs	Physiotherapist	1:1 Home/Group	Hospital	n/s

Figure 2 – Forest plot of caregiver included studies

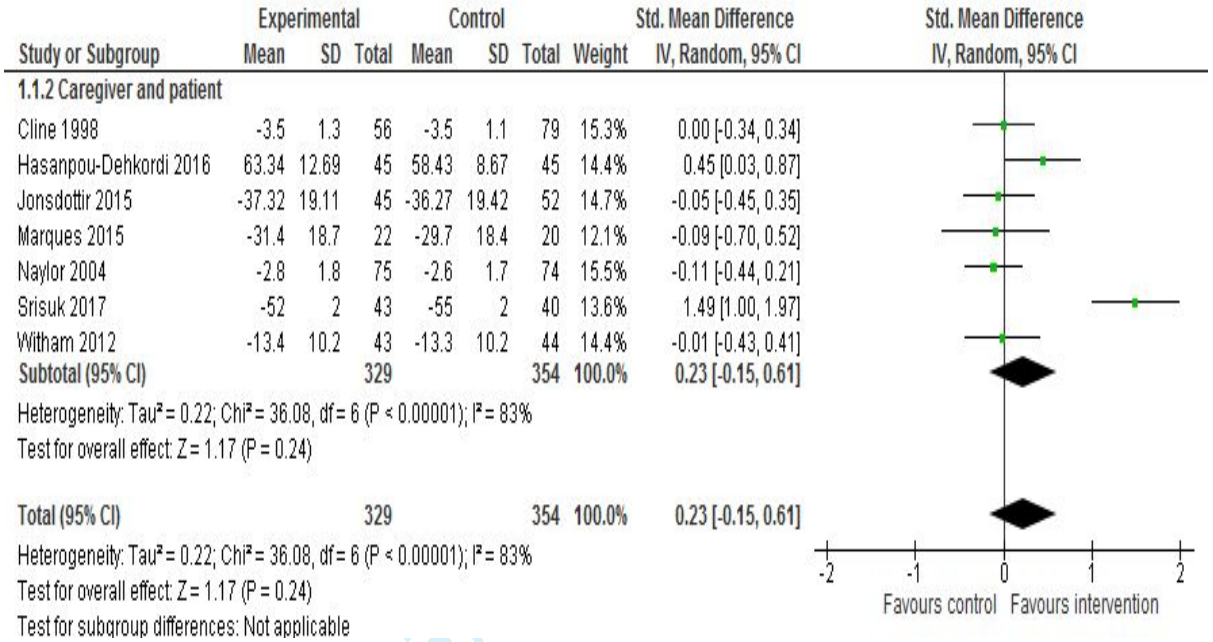


Figure 3 – Forest plot comparing caregiver included studies with studies not involving caregivers

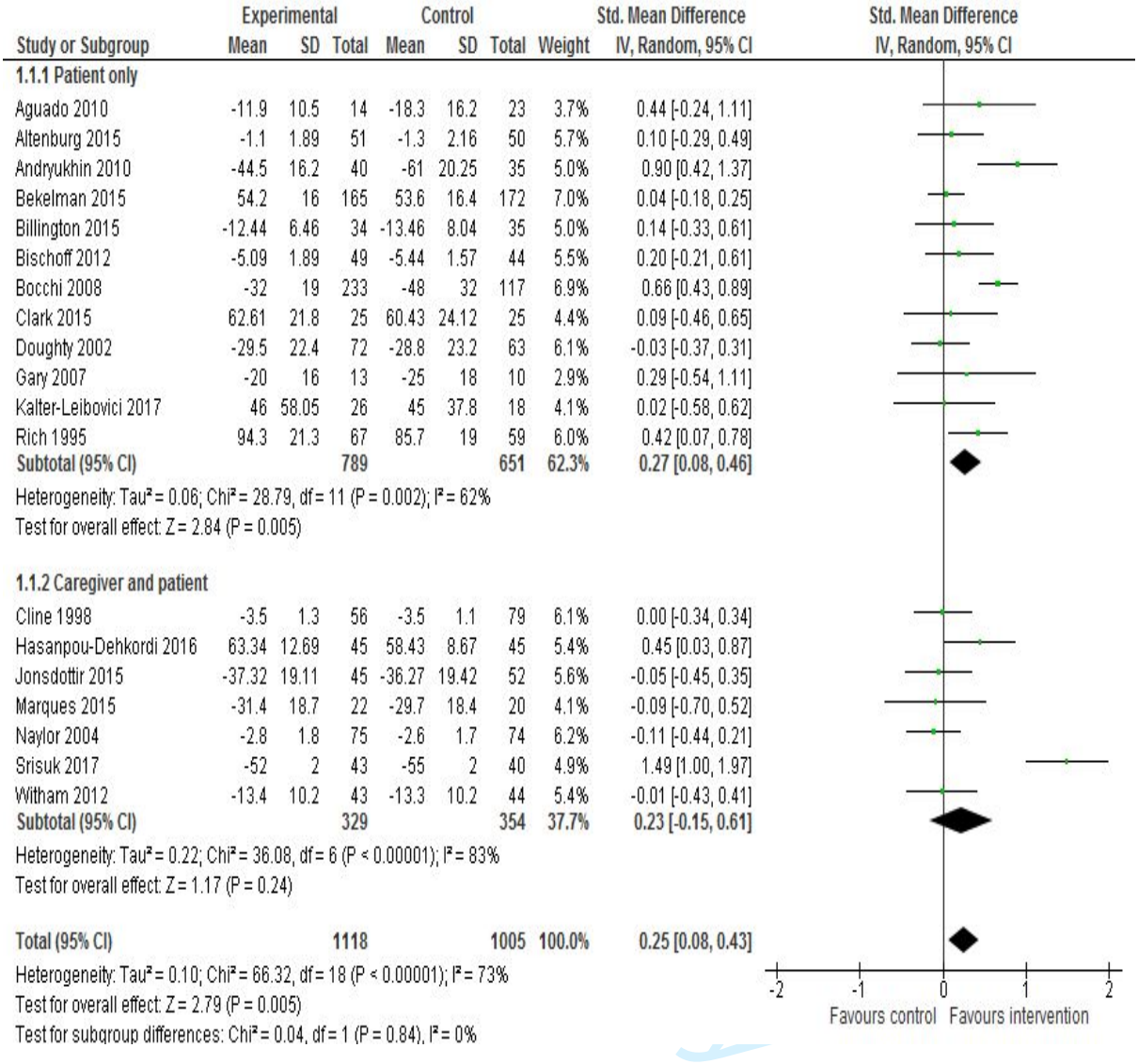


Table 1 - Matched Sampling Strategy

		Author (* = same study)	Year	Intervention	Dx	Country	Exercise
1	**Patient only**	Aguado et al.	2010	Education	HF	Spain	No
	Caregiver & Pt.	Agren et al *	2015	Psychoeducation	HF	Sweden	No
		Agren et al *	2015	Psychoeducation outcomes on partners	HF	Sweden	No
2	**Patient only**	Agvall, B. et al	2013	Education	HF	Sweden	No
	Caregiver & Pt.	Agren et al *	2012	Psychoeducation	HF	Sweden	No
		Liljeroos, Maria*	2017	Psychoeducation	HF	Sweden	No
		Liljeroos, M.*	2015	Ed/psychosocial	HF		No
3	**Patient only**	Bekelman, D. B.	2015	Team approach to disease managment	HF	USA	No
	Caregiver & Pt.	Naylor et al.	2004	Education - APN coordination	HF	USA	No
4	**Patient only**	Altenburg, W. A.	2015	Physical activity	COPD	Netherlands	Yes
	Caregiver & Pt.	Marques, A.	2015	Exercise, psychosocial support and education	COPD	Portugal	Yes
5	**Patient only**	Gary, R*	2007	Exercise and education	HF	USA	Yes
		Gary, R.*	2004/2006	Exercise and education	HF	USA	Yes
	Caregiver & Pt.	Azad et al.	2008	Ed and exercise	HF	Canada	Yes
6	**Patient only**	Doughty, R. N.	2002	Integrated care	HF	New Zealand	No
	Caregiver & Pt.	Deek, H.	2017	Educational intervention	HF	Lebanon	No
7	**Patient only**	Bocchi, E. A.	2008	Repeated education disease management	HF	Brazil	No
	Caregiver & Pt.	Hasanpour-Dehkordi, Ali	2016	Education	HF	Iran	No
8	**Patient only**	Bischoff, Erik W. M. A.	2012	Self-management programme	COPD	Netherlands	No

	Caregiver & Pt.	Jonsdottir, H.	2015	Education, smoking cessation, group self-management	COPD	Iceland	No
9	**Patient only**	Billington, J.	2015	Nurse led education	COPD	UK	No
	Caregiver & Pt.	Farquhar, Morag C.	2016	Education/Support	COPD (80%)	UK	No
10	**Patient only**	Kalter-Leibovici, O.	2017	Disease Management Programme	HF	Israel	No
	Caregiver & Pt.	Srisuk, Nittaya	2017	Relaxation response, education	HF	Thailand	No
11	**Patient only**	Clark, Angela P.	2015	Education/support at home	HF	USA	No
	Caregiver & Pt.	Martensson, J.	2005	Education and Management	HF	Sweden	No
12	**Patient only**	Andryukhin, A.	2010	Nurse education/disease management	HF	Russia	Yes
	Caregiver & Pt.	Witham, M	2012	Ed and exercise	HF	Scotland	Yes
13	**Patient only**	Rich, M. W.	1995	Multidisciplinary Intervention	HF	USA	No
	Caregiver & Pt.	Cline, C. M. J.	1998	Education post discharge	HF	Sweden	No

Table 1b

Summary of included studies

First Author	Year	Country	Diagnosis /Severity	Control Group (n)	Intervention Group (n)	Sample (Gender %F/Mean Age)	HRQoL Outcome Measure
+Aguado	2010	Spain	HF NYHA II-IV LVEF < 45%	Usual care. No education. Outpatient follow up. (64)	Education on self-management, activities habits and prevention (42)	106 IV: 23.8F / 77.8 C: 34.4F / 77.4	MLHFQ SF-36
±●Agren ±●Agren	2015 2015	Sweden	Post-operative HF	Standard care by members of a cardiac surgery care team. (17)	Patients and partners received psycho-educational support 2-4 weeks after discharge (25 Dyads)	42 Dyads IV: 12F(pt)/69(pt); 67(cg) C: 6F(pt) /70(pt) 66(cg)	SF-36
+Agvall	2013	Sweden	HF NYHA I-III EF < 50%	One initial visit to the GP as per local guidelines, follow-up was once a year (81)	Heart failure management programme for HF patients in primary care centres (79)	160 IV: 27F/75 C: 36F/75	SF-36
±●Agren ±●Liljeroos ±●Liljeroos	2012 2017 2015	Sweden	HF NYHA II -IV	Traditional inpatient care outpatient appointment as required. Partners not routinely included (71)	Integrated dyad care program with education and psychosocial support (84)	155 Dyads IV: 31F(pt)/69(pt); 67(cg) C: 19F(pt)/73(pt); 69(cg)	SF-36
+Bekelman	2015	USA	HF NYHA I-IV EF <50%	Received care from their regular health professionals and regular telehealth nurses Received information sheets describing self-care for HF & weighing scale (197)	3 Components Team review of medical records Telemonitoring Self-care education programme including medication, diet, depression &signs &symptoms of decompensation (187)	392 IV: 5F/67.3 C: 2F/67.9	KCCQ
±Naylor	2004	USA	HF Systolic & Diastolic	Routine Care Site-specific heart failure–pt management/discharge planning /referrals as required 58% received referrals for skilled nursing/physical therapy (121)	Discharge planning and 3 month home follow up (118)	239 76F/57%	MLHFQ

Table 1b

Summary of included studies

First Author	Year	Country	Diagnosis /Severity	Control Group (n)	Intervention Group (n)	Sample (Gender %F/Mean Age)	HRQoL Outcome Measure
+Altenburg	2015	Netherlands	COPD GOLD I-IV FEV1 (%pred): 60 (40-75)	Usual Care PR group received 9 weeks exercise training (77)	12- weeks' customized lifestyle physical activity counselling programme 3 groups, PR, PC, SC (78)	144 34F/62	SF-36 Clinical COPD Questionnaire Chronic Respiratory Questionnaire
±Marques	2015	Portugal	COPD FEV 1(% pred): IV: 67(±22.4) C: 74.3(±21.7)	12 weeks of PR, psychosocial support and exercise for pt. No involvement of family (28)	12 weeks of PR composed of exercise training and psychosocial support and education. Family participated in psychosocial and education sessions (28)	56 Dyads IV:18.2F(pt)/ 68.8(pt); 62(cg C: 50F(pt)/ 65.9(pt), 55(cg)	SGRQ
+Andryukhin	2010	Russia	HF NYHA I -III Preserved EF	Usual care as per national guidelines (41)	Educational programme 4 weekly group sessions Targeting lifestyle modifications & risk factors (44)	85 IV: 72.7F/66.5 C: 65.8F/68	MLHFQ
±Azad	2008	Canada	HF NYHA I-IV	Optimal medical care (45)	Interdisciplinary self-management including exercise, diet, daily activities, support and HF education (46)	91 IV:n/sF/74.2 C: n/sF/75/8	MLHFQ SF-36
+Doughty	2002	New Zealand	HF NYHA III-IV LVEF % IV: 30.6 C: 33.8	Care of GP & additional follow up if recommended by medical team (97)	One to one education with nurse 6 weekly visits with GP or HF clinic Group education. Self-management of HF (100)	197 IV: 36F/72.5 C: 44F/73.5	MLHFQ
±Deek	2017	Lebanon	HF EF Mean 36 NYHA II/III 95%	Usual Care No education session (130)	Pts and cg received one comprehensive family-centred educational session on self-care and symptoms management (126)	256 IV:47F/65 C: 43F/68)	SF12-V2

Table 1b

Summary of included studies

First Author	Year	Country	Diagnosis /Severity	Control Group (n)	Intervention Group (n)	Sample (Gender %F/Mean Age)	HRQoL Outcome Measure
+Bocchi	2008	Brazil	HF EF <45%: C:=80% IV: = 81.6%	Standard follow-up medical visits – catered to patients' needs (117)	Disease Management Programme; consisting of a long-term repetitive multidisciplinary education program and telephone monitoring	350 IV: 29F/50 C:36F/52)	MLHFQ
±Hassanpour-Dehkordi	2016	Iran	HF NYHA III: IV:72% C:76% EF OF 35%-45% IV: 75% C: 77%	n/s (45)	Family training and support at home (45)	90 IV: 40F/60.8 C: 38F/59.1)	SF-36
+Bischoff	2012	Netherlands	COPD FEV1(% pred.): Self-mgt. group: 66.3 Routine monitoring: 62.9 (14.4) C: 67.0 (18.0)	As per guidelines in general practices in Netherlands (55)	Self-mgt group: Modules & written action plan. Education on self-mgt. & early recognition of symptoms (55) Routine monitoring: routine visits to GP office including evaluation of symptoms (55)	165 Self-mgt: 33F/65.5 Routine Monitoring: 24F/65.8 C: 49F/63.5	SGRQ
±Jonsdottir	2015	Iceland	COPD GOLD I-IV FEV1(% pred): IV: 54 C: 61	Traditional healthcare i.e. visits to primary health centre, physician or lung specialist (52)	Patient/family education & discussion Smoking cessation Peer education Self-mgt. of COPD (48)	119 IV: 29F/59.4 C: 25F/58.6	SGRQ
+Billington	2015	UK	COPD Mild & Moderate FEV1 (% pred) IV: 55.78 C: 58.23	2 page self-mgt. plan Guidelines on symptoms Medications in emergency (38)	Telephone education Use of written action plan Medication advice & support (35)	73 IV: 49F/72 C: 55F/72	CAT
±Farquhar	2016	UK	COPD GOLD I-IV	Wait list control (43)	Manage symptoms of breathlessness psychological, social and physical approach (44)	87 IV: 36F(pt)/72.3(pt);62.5(cg) C: 42F(pt)/72.2(pt); 62(cg)	Chronic Respiratory Q. EQ-5D

Table 1b

Summary of included studies

First Author	Year	Country	Diagnosis /Severity	Control Group (n)	Intervention Group (n)	Sample (Gender %F/Mean Age)	HRQoL Outcome Measure
+Kalter-Leibovici	2017	Israel	HF (all types) NYHA I-IV	Usual care Referred to primary care with treatment plan by Cardiologist (678)	Regular contact with nurses for self-care education monitoring signs & symptoms medication mgt. & HF clinic follow up (682)	1,360 IV: 31F/70.8 C: 24F/70.7	SF-36
±Srisuk	2017	Thailand	HF NYHA I-IV	Usual care Standard medical & nursing care (50)	HF education manual & DVD Counselling Telephone follow up (50)	100 Dyads IV: 56F(pt)/65(pt);39(cg) C: 50F(pt)/59(pt);43(cg)	MLHFQ SF-12
+Clark	2015	USA	HF NYHA I-III	Received notebook on information on health & health promotion (25)	Building self-efficacy using education & skill building Encouraged to contact nurses for support (25)	50 IV: 64F/62.4 C: 40F/62.4	KCCQ
±Mårtennson	2005	Sweden	HF NYHA II-IV	Team based care Home visits included (75)	HF education via telephone & home visits (78)	153 46F/79	SF-36 MLHFQ
+●Gary +●Gary +●Gary	2007 2006 2004	USA USA USA	HF NYHA II-III LVEF ≥45%	12 week education group not educated on exercise self-mgt. topics for HF Weekly home visits Received patient manual (10)	In addition to control group 12 week walking intervention (13)	23 100F/68	MLHFQ
±Witham	2012	Scotland	HF NYHA II-III	Received booklet with general healthcare advice (54)	Exercise classes clinic & home Cognitive behavioural techniques utilised Received same booklet as control group (53)	107 IV: 34F(pt)/80(pt);65(cg) C: 31F(pt)/79(pt); 70(cg)	MLHFQ EQ-5D

Table 1b

Summary of included studies

First Author	Year	Country	Diagnosis /Severity	Control Group (n)	Intervention Group (n)	Sample (Gender %F/Mean Age)	HRQoL Outcome Measure
+Rich	1995	USA	HF	Standard care as per physician treatment (140)	Intensive HF education Individualised dietary plan Medication advice Telephone & home follow up (142)	282 Chronic IV: 68F/80 C: 59F/78	HF Questionnaire
±Cline	1998	Sweden	HF	Outpatient clinic follow up. Treating Physician evaluated & treated as appropriate (110)	Education on pharmacological & non-pharmacological mgt. at home In hospital presentations on signs & symptoms Use of diary to record information Follow up by nurse via telephone and home visit Doctor appointments also offered at 1 & 4 months (80)	190 IV: 45F/76 C: 45F/75	Quality of life in HF MLHFQ NHP

Studies are grouped with their matched pairing, + = patient only, ± = patient and caregiver, ●= Same study, LVEF=Left Ventricular Ejection Fraction, IV = Intervention group, C = Control group, MLHFQ = Minnesota Living with Heart Failure Questionnaire, SF-36 = Short Form 36, pt=patient, cg=caregiver, EF = Ejection Fraction, KCCQ = Kansas City Cardiomyopathy Questionnaire, GOLD = Global Initiative for Chronic Obstructive Lung Disease, FEV1=forced expiration volume in 1 s, PR = Pulmonary Rehabilitation, PC = Primary Care, SC=Secondary Care, SF12-V2 = Short Form-12Version 2, SGRQ = St. George's Respiratory Questionnaire, NYHA = New York Heart Association, n/s = not stated, ICICE = Improving Chronic Illness Care Evaluation, HFSS = Heart Failure Symptom Scale, , SF-12 = Short Form 12, Self-mgt. = self-management, CAT = COPD Assessment Tool, NHP = Nottingham Health Profile

Risk of bias assessment

Author	Random Sequence generation	Allocation concealment	Blinding of participants/ personnel	Blinding of outcome assessment	Incomplete data reporting	Selective reporting	Groups balanced at baseline	Did groups receive same treatment
Aguado 2010	Low Risk	Unclear Risk	High Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk
Agren 2015	Low Risk	Unclear Risk	High Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk
Agvall 2013	Low Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk	Low Risk	Low Risk
Agren 2012 Liljeroos 2015/2017	Low Risk	Unclear Risk	High Risk	Unclear Risk	High Risk	Low Risk	Low Risk	Low Risk
Bekelman 2015	Low Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk	Low Risk	Low Risk
Naylor 2004	Low Risk	Low Risk	High Risk	Low Risk	High Risk	Low Risk	Low Risk	Unclear Risk
Altenburg 2015	Low Risk	Low Risk	High Risk	High Risk	High Risk	High Risk	Low Risk	High Risk
Marques 2015	Low Risk	Low Risk	Unclear Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk

Risk of bias assessment (based on cochrance collaboration tool for assessing bias in **RCTs**)

Author	Random Sequence generation	Allocation concealment	Blinding of participants/ personnel	Blinding of outcome assessment	Incomplete data reporting	Selective reporting	Groups balanced at baseline	Did groups receive same treatment
Andryuhkin 2010	Unclear Risk	Low Risk	High Risk	Low Risk	Low Risk	Unclear Risk	Low Risk	Low Risk
Azad 2008	Low Risk	Low Risk	High Risk	Low Risk	Unclear Risk	Low Risk	Low Risk	Low Risk
Doughty 2002	Low Risk	Unclear Risk	Unclear Risk	High Risk	High Risk	Low Risk	Low Risk	Low Risk
Deek 2017	Low Risk	Low Risk	High Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk
Bocchi 2008	Low Risk	Low Risk	High Risk	Low Risk	High Risk	Low Risk	Low Risk	Unclear Risk
Hasanpour-Dehkordi 2016	Unclear Risk	Unclear Risk	High Risk	Unclear Risk	Low Risk	Low Risk	Low Risk	Unclear Risk
Bischoff 2012	Low Risk	Low Risk	High Risk	Unclear Risk	Low Risk	Low Risk	Low Risk	High Risk
Jonsdottir 2015	Low Risk	Unclear Risk	High Risk	Low Risk	Low Risk	Unclear Risk	Low Risk	Low Risk
Billington 2015	Low Risk	Unclear Risk	Unclear Risk	Low Risk	Low Risk	Low Risk	Low Risk	Low Risk

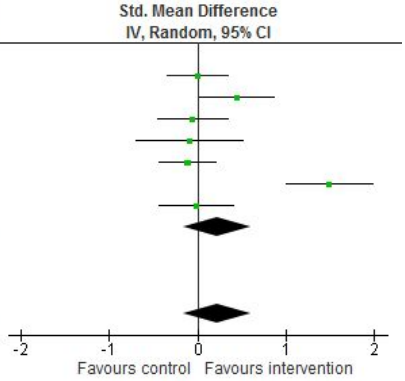
Risk of bias assessment (based on cochrance collaboration tool for assessing bias in **RCTs**)

Author	Random Sequence generation	Allocation concealment	Blinding of participants/ personnel	Blinding of outcome assessment	Incomplete data reporting	Selective reporting	Groups balanced at baseline	Did groups receive same treatment
Farquhar 2016	Low Risk	Low Risk	High Risk	Low Risk	Low Risk	High Risk	Low Risk	Low Risk
Kalter-Leibovici 2017	Low Risk	Low Risk	High Risk	High Risk	Low Risk	Unclear Risk	Low Risk	Low Risk
Srisuk 2017	Low Risk	Low Risk	High Risk	Low Risk	Low Risk	Unclear Risk	Low Risk	Low Risk
Clark 2015	Unclear Risk	Unclear Risk	High Risk	Unclear Risk	Unclear Risk	Low Risk	Low Risk	Low Risk
Mårtensson 2005	Low Risk	Unclear Risk	High Risk	Unclear Risk	High Risk	High Risk	Low Risk	Low Risk
Gary 2006/2007	Unclear Risk	Unclear Risk	High Risk	Unclear Risk	High Risk	Unclear Risk	Low Risk	Low Risk
Witham 2012	Low Risk	Low Risk	High Risk	Low Risk	Low Risk	Low Risk	Low Risk	Low Risk
Rich 1995	Low Risk	Low Risk	High Risk	Unclear Risk	Unclear Risk	Low Risk	Low Risk	Low Risk
Cline 1998	Low Risk	Unclear Risk	High Risk	Low Risk	Unclear Risk	Low Risk	Low Risk	Low Risk

Sensitivity analysis:

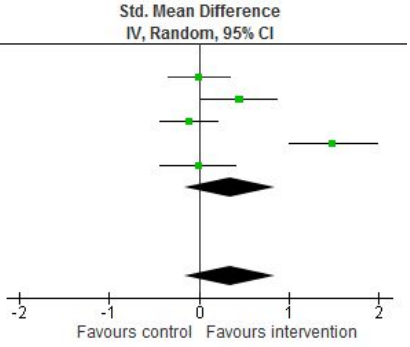
Caregiver included studies - With COPD and HF

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.1.2 Caregiver and patient								
Cline 1998	-3.5	1.3	56	-3.5	1.1	79	15.3%	0.00 [-0.34, 0.34]
Hasanpou-Dehkordi 2016	63.34	12.69	45	58.43	8.67	45	14.4%	0.45 [0.03, 0.87]
Jonsdottir 2015	-37.32	19.11	45	-36.27	19.42	52	14.7%	-0.05 [-0.45, 0.35]
Marques 2015	-31.4	18.7	22	-29.7	18.4	20	12.1%	-0.09 [-0.70, 0.52]
Naylor 2004	-2.8	1.8	75	-2.6	1.7	74	15.5%	-0.11 [-0.44, 0.21]
Srisuk 2017	-52	2	43	-55	2	40	13.6%	1.49 [1.00, 1.97]
Witham 2012	-13.4	10.2	43	-13.3	10.2	44	14.4%	-0.01 [-0.43, 0.41]
Subtotal (95% CI)			329			354	100.0%	**0.23 [-0.15, 0.61]**
Heterogeneity: Tau² = 0.22; Chi² = 36.08, df = 6 (P < 0.00001); I² = 83%								
Test for overall effect: Z = 1.17 (P = 0.24)								
Total (95% CI)			329			354	100.0%	**0.23 [-0.15, 0.61]**
Heterogeneity: Tau² = 0.22; Chi² = 36.08, df = 6 (P < 0.00001); I² = 83%								
Test for overall effect: Z = 1.17 (P = 0.24)								
Test for subgroup differences: Not applicable								



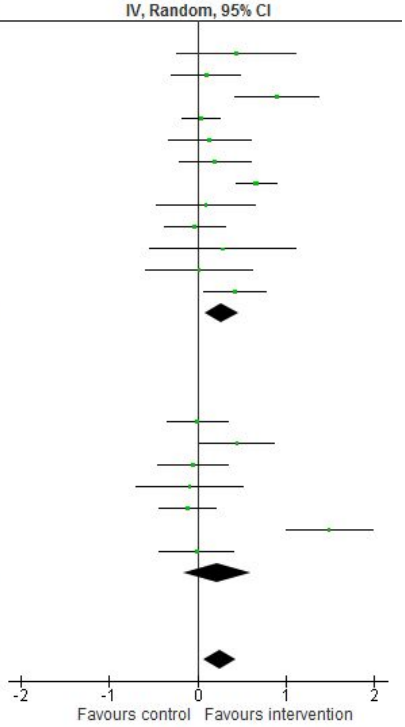
Caregiver included studies - Without COPD, HF only

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.1.2 Caregiver and patient								
Cline 1998	-3.5	1.3	56	-3.5	1.1	79	20.7%	0.00 [-0.34, 0.34]
Hasanpou-Dehkordi 2016	63.34	12.69	45	58.43	8.67	45	19.8%	0.45 [0.03, 0.87]
Naylor 2004	-2.8	1.8	75	-2.6	1.7	74	20.9%	-0.11 [-0.44, 0.21]
Srisuk 2017	-52	2	43	-55	2	40	18.9%	1.49 [1.00, 1.97]
Witham 2012	-13.4	10.2	43	-13.3	10.2	44	19.8%	-0.01 [-0.43, 0.41]
Subtotal (95% CI)			262			282	100.0%	**0.34 [-0.16, 0.85]**
Heterogeneity: Tau² = 0.29; Chi² = 33.77, df = 4 (P < 0.00001); I² = 88%								
Test for overall effect: Z = 1.32 (P = 0.19)								
Total (95% CI)			262			282	100.0%	**0.34 [-0.16, 0.85]**
Heterogeneity: Tau² = 0.29; Chi² = 33.77, df = 4 (P < 0.00001); I² = 88%								
Test for overall effect: Z = 1.32 (P = 0.19)								
Test for subgroup differences: Not applicable								



Patient only studies compared with Caregiver included studies – With COPD

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.1.1 Patient only								
Aguado 2010	-11.9	10.5	14	-18.3	16.2	23	3.7%	0.44 [-0.24, 1.11]
Altenburg 2015	-1.1	1.89	51	-1.3	2.16	50	5.7%	0.10 [-0.29, 0.49]
Andryukhin 2010	-44.5	16.2	40	-61	20.25	35	5.0%	0.90 [0.42, 1.37]
Bekelman 2015	54.2	16	165	53.6	16.4	172	7.0%	0.04 [-0.18, 0.25]
Billington 2015	-12.44	6.46	34	-13.46	8.04	35	5.0%	0.14 [-0.33, 0.61]
Bischoff 2012	-5.09	1.89	49	-5.44	1.57	44	5.5%	0.20 [-0.21, 0.61]
Bocchi 2008	-32	19	233	-48	32	117	6.9%	0.66 [0.43, 0.89]
Clark 2015	62.61	21.8	25	60.43	24.12	25	4.4%	0.09 [-0.46, 0.65]
Doughty 2002	-29.5	22.4	72	-28.8	23.2	63	6.1%	-0.03 [-0.37, 0.31]
Gary 2007	-20	16	13	-25	18	10	2.9%	0.29 [-0.54, 1.11]
Kalter-Leibovici 2017	46	58.05	26	45	37.8	18	4.1%	0.02 [-0.58, 0.62]
Rich 1995	94.3	21.3	67	85.7	19	59	6.0%	0.42 [0.07, 0.78]
Subtotal (95% CI)			**789**			**651**	**62.3%**	**0.27 [0.08, 0.46]**
Heterogeneity: Tau² = 0.06; Chi² = 28.79, df = 11 (P = 0.002); I² = 62%								
Test for overall effect: Z = 2.84 (P = 0.005)								
1.1.2 Caregiver and patient								
Cline 1998	-3.5	1.3	56	-3.5	1.1	79	6.1%	0.00 [-0.34, 0.34]
Hasanpou-Dehkordi 2016	63.34	12.69	45	58.43	8.67	45	5.4%	0.45 [0.03, 0.87]
Jonsdottir 2015	-37.32	19.11	45	-36.27	19.42	52	5.6%	-0.05 [-0.45, 0.35]
Marques 2015	-31.4	18.7	22	-29.7	18.4	20	4.1%	-0.09 [-0.70, 0.52]
Naylor 2004	-2.8	1.8	75	-2.6	1.7	74	6.2%	-0.11 [-0.44, 0.21]
Srisuk 2017	-52	2	43	-55	2	40	4.9%	1.49 [1.00, 1.97]
Witham 2012	-13.4	10.2	43	-13.3	10.2	44	5.4%	-0.01 [-0.43, 0.41]
Subtotal (95% CI)			**329**			**354**	**37.7%**	**0.23 [-0.15, 0.61]**
Heterogeneity: Tau² = 0.22; Chi² = 36.08, df = 6 (P < 0.00001); I² = 83%								
Test for overall effect: Z = 1.17 (P = 0.24)								
Total (95% CI)			**1118**			**1005**	**100.0%**	**0.25 [0.08, 0.43]**
Heterogeneity: Tau² = 0.10; Chi² = 66.32, df = 18 (P < 0.00001); I² = 73%								
Test for overall effect: Z = 2.79 (P = 0.005)								
Test for subgroup differences: Chi² = 0.04, df = 1 (P = 0.84), I² = 0%								



Patient only studies compared with Caregiver included studies – Without COPD

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.1.1 Patient only								
Aguado 2010	-11.9	10.5	14	-18.3	16.2	23	5.3%	0.44 [-0.24, 1.11]
Andryukhin 2010	-44.5	16.2	40	-61	20.25	35	6.8%	0.90 [0.42, 1.37]
Bekelman 2015	54.2	16	165	53.6	16.4	172	9.0%	0.04 [-0.18, 0.25]
Bocchi 2008	-32	19	233	-48	32	117	9.0%	0.66 [0.43, 0.89]
Clark 2015	62.61	21.8	25	60.43	24.12	25	6.2%	0.09 [-0.46, 0.65]
Doughty 2002	-29.5	22.4	72	-28.8	23.2	63	8.1%	-0.03 [-0.37, 0.31]
Gary 2007	-20	16	13	-25	18	10	4.2%	0.29 [-0.54, 1.11]
Kalter-Leibovici 2017	46	58.05	26	45	37.8	18	5.8%	0.02 [-0.58, 0.62]
Rich 1995	94.3	21.3	67	85.7	19	59	7.9%	0.42 [0.07, 0.78]
Subtotal (95% CI)			**655**			**522**	**62.3%**	**0.32 [0.07, 0.56]**
Heterogeneity: Tau² = 0.09; Chi² = 27.19, df = 8 (P = 0.0007); I² = 71%								
Test for overall effect: Z = 2.53 (P = 0.01)								
1.1.2 Caregiver and patient								
Cline 1998	-3.5	1.3	56	-3.5	1.1	79	8.0%	0.00 [-0.34, 0.34]
Hasanpou-Dehkordi 2016	63.34	12.69	45	58.43	8.67	45	7.4%	0.45 [0.03, 0.87]
Naylor 2004	-2.8	1.8	75	-2.6	1.7	74	8.2%	-0.11 [-0.44, 0.21]
Srisuk 2017	-52	2	43	-55	2	40	6.7%	1.49 [1.00, 1.97]
Witham 2012	-13.4	10.2	43	-13.3	10.2	44	7.3%	-0.01 [-0.43, 0.41]
Subtotal (95% CI)			**262**			**282**	**37.7%**	**0.34 [-0.16, 0.85]**
Heterogeneity: Tau² = 0.29; Chi² = 33.77, df = 4 (P < 0.00001); I² = 88%								
Test for overall effect: Z = 1.32 (P = 0.19)								
Total (95% CI)			**917**			**804**	**100.0%**	**0.32 [0.09, 0.55]**
Heterogeneity: Tau² = 0.14; Chi² = 61.60, df = 13 (P < 0.00001); I² = 79%								
Test for overall effect: Z = 2.77 (P = 0.006)								
Test for subgroup differences: Chi² = 0.01, df = 1 (P = 0.93), I² = 0%								

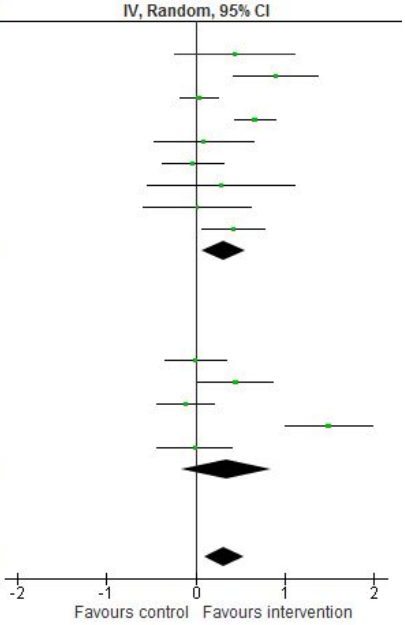


Figure 2 Caregiver studies with Physical Component Scale of SF-36 included

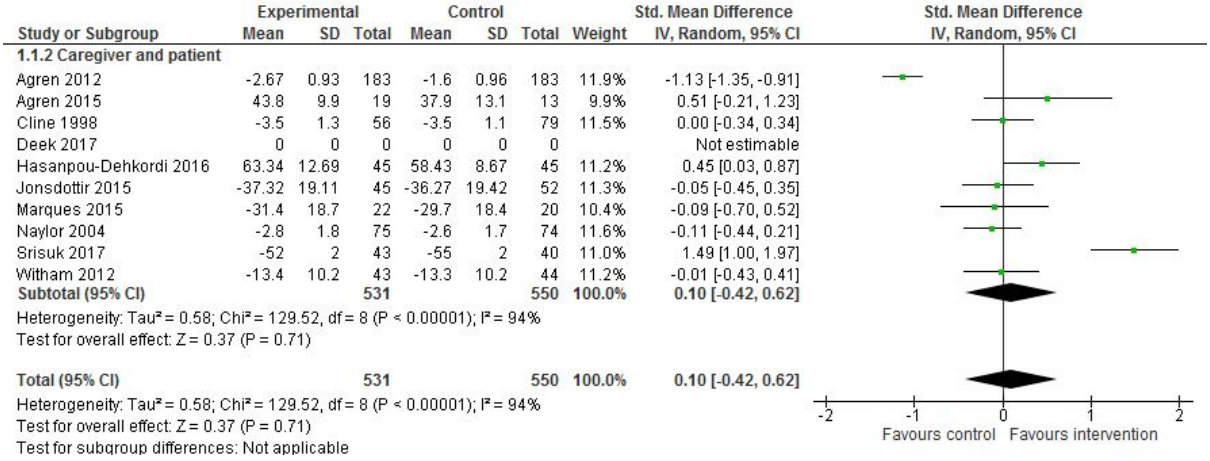


Figure 3 Caregiver studies with Mental Component Scale of SF-36 Included

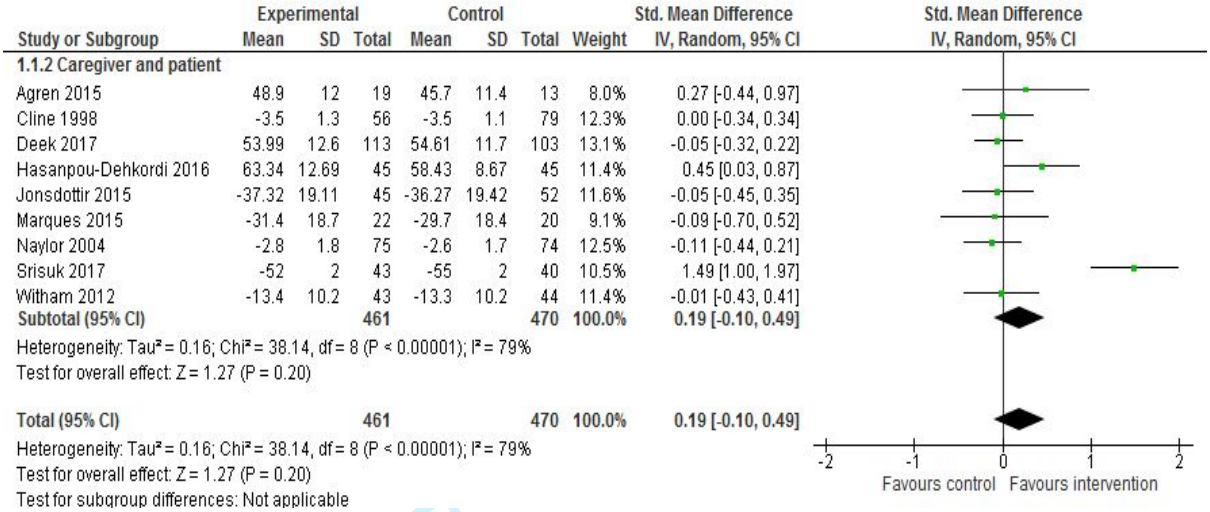


Table 3 Vote Counting

Author Year	Time point	Outcome Measure	Outcome Mean (SD) Unless otherwise specified "C" – Intervention with pt. & cg. V "Non-C" Control group with pt. & cg. "P" – Intervention with pt. only V "Non-P" Control group with pt. only	Categorisation of effect	Comments
Aguado 2010	Baseline	MLHFQ	51.2 (27.7) v 48.6 (25.8), p=0.77	P = Non-P	
	24 months	MLHFQ	11.9 (10.5) v 18.3 (16.2), p=0.19	P = Non-P	
	Baseline	SF-36 Physical health	35 (8) v 40 (11), p = 0.14	P = Non-P	Between group p values calculated using STATA 15.0
	24 months	SF-36 Physical health	50 (5) v 44 (3), p = 0.00	P > Non-P	
	Baseline	SF-36 Mental health	37 (12) v 36 (13), p = 0.81	P = Non-P	
	24 months	SF-36 Mental health	52 (7) v 44 (6), p=0.00	P > Non-P	
Statistical Test: Logistic regression comparison of means for paired data, statistical significance $p < 0.05$					
Agren 2012	Baseline	SF-36 PCS	33.6 (6.8) v 31.8 (8.8), p = 0.46	C = Non-C	
	3 months	SF-36 PCS	39.7 (11.2) v 36.7 (14.4), p = 0.45	C = Non-C	Between group p values calculated using STATA 15.0
	12 months	SF-36 PCS	43.8 (9.9) v 37.9 (13.1), p=0.15	C = Non-C	
	Baseline	SF-36 MCS	40.2 (12.7) v 43.4 (14.0), p =0.44	C = Non-C	
	3 months	SF-36 MCS	50.6 (12.7) v 51.7 (11.1) , p= 0.77	C = Non-C	

12 months	SF-36 MCS	48.9 (12.0) v 45.7 (11.4), p = 0.45	C = Non-C
Baseline	SF-36-PF	48.8 (23.3) v 44.2 (27.8), p = 0.56	C = Non-C
3 months	SF-36-PF	65.8 (28.0) v 61.1 (26.2), p = 0.58	C = Non-C
12 months	SF-36-PF	76.0 (19.9) v 57.4 (31.2), p = 0.04	C > Non-C
Baseline	SF-36-RP	8.0 (23.6) v 6.6 (18.4), p = 0.83	C = Non-C
3 months	SF-36-RP	32.9 (41.7) v 35.7 (41.3), p = 0.83	C = Non-C
12 months	SF-36-RP	46.0 (45.1) v 32.7 (41.3), p = 0.4	C = Non-C
Baseline	SF-36-BP	56.7 (23.9) v 54.3 (24.8), p = 0.75	C = Non-C
3 months	SF-36-BP	73.9 (24.6) v 63.8 (35.4), p = 0.28	C = Non-C
12 months	SF-36-BP	77.3 (25.2) v 70.3 (31.7), p = 0.49	C = Non-C
Baseline	SF-36-GH	57.6 (17.6) v 58.7 (21.1), p = 0.85	C = Non-C
3 months	SF-36-GH	66.9 (19.0) v 60.1 (24.7), p = 0.31	C = Non-C
12 months	SF-36-GH	66.0 (20.1) v 56.3 (26.1), p=0.24	C = Non-C
Baseline	SF-36-VT	40.8 (22.6) v 42.1 (22 .8), p = 0.85	C = Non-C
3 months	SF-36-VT	60.0 (21.9) v 58.6 (24.0), p = 0.84	C = Non-C
12 months	SF-36-VT	63.2 (22.1) v 51.5 (22.8), p = 0.15	C = Non-C

	Baseline	SF-36-SF	55.0 (27.9) v 65.8 (30.9), p = 0.24	C = Non-C	
	3 months	SF-36-SF	86.2 (17.6) v 84.8 (23.6), p = 0.82	C = Non-C	
	12 months	SF-36-SF	85.5 (19.2) v 75.0 (27.5), p = 0.21	C = Non-C	
	Baseline	SF-36-RE	36.0 (44.0) v 36.8 (44.3), p = 0.95	C = Non-C	
	3 months	SF-36-RE	66.7 (47.1) v 69.0 (42.3), p = 0.87	C = Non-C	
	12 months	SF-36-RE	63.2 (42.9) v 60.3 (40.6), p = 0.84	C = Non-C	
	Baseline	SF-36-MH	67.8 (22.3) v 71.2 (23.0), p = 0.63	C = Non-C	
	3 months	SF-36-MH	80.8 (20.1) v 82.0 (16.3), p = 0.83	C = Non-C	
	12 months	SF-36-MH	82.3 (20.3) v 70.2 (18.8), p = 0.09	C = Non-C	

Statistical test: Student *t* test, statistical significance $p < 0.05$

Agvall 2013	SF-36			
	Physical Functioning (PF)	2 (23) v -2 (23), p = 0.27	P = Non-P	Mean difference between baseline and 12 months SD calculated from p value
	Role Physical (RP)	7 (95) v 2 (95), p=0.51	P = Non-P	
	Bodily Pain (BP)	-2(31) v 0 (31), p = 0.41	P = Non-P	
	General Health (GH)	-1(33), v -1(33), p =0.7	P = Non-P	
	Vitality (VT)	0(68), v -2(68), p=0.71	P = Non-P	
	Social Role Functioning (SF)	3 (63), v -5(63), p = 0.11	P = Non-P	
	Role Emotional (RE)	4(93), v -10 (93), p = 0.06	P = Non-P	

		Mental Health (MH)	3(65), v -2 (65), p=0.33	P = Non-P	
Statistical test: Student's unpaired and paired two-sided t-test, statistical significance $p < 0.05$					
Liljeroos 2015	Baseline	SF-36-PCS	33.6(8.7) v 31.8(10), p = 0.23	C = Non-C	p values calculated using STATA 15.0
	Baseline	SF-36-MCS	39.9 (12.8) v 42.2 (12.6), p = 0.26	C = Non-C	
Difference in score between baseline and 3 months		SF-36-PCS	-0.5 (7.6) v -0.5 (6.4), p = 0.99	C = Non-C	
		SF-36 MCS	0.3 (8.8) v -3.1 (12.5), p = 0.1	C = Non-C	
Difference in score between baseline and 12 months		SF-36 PCS	-1.9 (9.8) v -0.5 (7.9), p =0.39	C = Non-C	
		SF-36-MCS	-4.55 (11.2) v -3.1(10.4), p = 0.88	C = Non-C	
Baseline – 24 months		SF-36 PCS	-2.67 (0.93) v -1.6 (0.96), p = 0.415	C = Non-C	Mean difference from baseline to 24 months
Baseline – 24 months		SF -36 MCS	3.49 (1.1) v 2.56 (1.2), p = 0.601	C = Non-C	
Baseline – 24 months		SF-36 PF	-4.28 (2.26) v -1.48 (1.88), p = 0.325	C = Non-C	
Baseline – 24 months		SF -36 RP	-3.5 (4.57) v -1.68 (4.12), p = 0.777	C = Non-C	
Baseline – 24 months		SF-36 BP	-3.33 (2.91) v -0.77 (3.04), p= 0.586	C = Non-C	
Baseline – 24 months		SF-36 GH	-0.18 (2.07) v -2.58 (1.85), p = 0.428	C = Non-C	
Baseline – 24 months		SF-36-VT	5.23 (2.18) v 2.89 (2.19), p = 0.473	C = Non-C	
Baseline – 24 months		SF-36-SF	1.4 (2.36) v 4.58 (2.48), p = 0.371	C = Non-C	

Baseline – 24 months		SF-36-RE	7.66 (4.32) v 5.05 (4.15), p = 0.677	C = Non-C	
Baseline – 24 months		SF-36-MH	3.3 (1.89) v 2.87 (1.89), p = 0.888	C = Non-C	
Statistical test: Multiple linear regression analyses (robust variance estimates), statistical significance $p < 0.05$					
Bekelman 2015	Baseline	KCCQ	37.9 (13.3) v 36.9(14.6), p = 0.48	P = Non-P	p values calculated using STATA 15.0
	3 months	KCCQ	43.8(10.4) v 43.7(10.6), p = 0.92	P = Non-P	
	6 months	KCCQ	47.2(11.1) v 46.9 (11.3), p = 0.8	P = Non-P	
	12 months	KCCQ	54.2 (16) v 53.6(16.4), p = 0.73	P = Non-P	
Statistical test: Paired t test and likelihood-based random-effects model, statistical significance p < 0.05					
Naylor 2004	Baseline	MLHFQ Total	2.4 (0.7) v 2.3 (0.7), p = 0.27	C = Non-C	
		MLHFQ Emotional	3.3 (1.3) v 3.3 (1.2), p = 1	C < Non-C	p values calculated using STATA 15.0
		MLHFQ Physical	2.8 (0.9) v 2.8 (0.9), p = 1	C < Non-C	
	2 weeks	MLHFQ Total	3 (1.2) v 2.7 (1.2), p = 0.06	C = Non-C	
		MLHFQ Emotional	3.6 (1.3) v 3.3 (1.4), p = 0.09	C = Non-C	
		MLHFQ Physical	3.5 (1.2) v 3 (1.2), p = 0	C > Non-C	

6 weeks	MLHFQ Total	3.1 (1.3) v 2.9 (1.4), p = 0.28	C = Non-C
	MLHFQ Emotional	3.5 (1.5) v 3.3 (1.6), p = 0.35	C = Non-C
	MLHFQ Physical	3.6 (1.4) v 3.3 (1.5), p = 0.15	C = Non-C
12 weeks	MLHFQ Total	3.2 (1.5) v 2.7 (1.5), p = 0.02	C > Non-C
	MLHFQ Emotional	3.6 (1.6) v 3.2 (1.7), p = 0.09	C = Non-C
	MLHFQ Physical	3.6 (1.4) v 3.1 (1.6), p = 0.02	C > Non-C
26 weeks	MLHFQ Total	2.9 (1.6) v 2.6 (1.5), p = 0.19	C = Non-C
	MLHFQ Emotional	3.2 (1.7) v 3.1 (1.8), p = 0.7	C = Non-C
	MLHFQ Physical	3.3 (1.6) v 3 (1.7), p = 0.22	C = Non-C
52 weeks	MLHFQ Total	2.8 (1.8) v 2.6 (1.7), p = 0.48	C = Non-C
	MLHFQ		

	Emotional	3.1 (1.9) v 3 (1.9), p = 0.74	C = Non-C	
	MLHFQ Physical	3.1 (1.9) v 2.9 (1.9), p = 0.52	C = Non-C	

Statistical test: Intention-to-treat principle, statistical significance $p < 0.05$

Altenburg 2015			**Median (IQR)**		
			All intervention groups		
	Baseline	CRQ	109 (87-119) v 102(86 -118), p = 0.31	P = Non-P	p value calculated using STATA 15 after imputing mean and SD
	3 months	CRQ	112 (91-122) v 114 (96-126), p = 0.79	P = Non-P	
	15 months	CRQ	113 (89-129) v 114 (94-129), p = 0.92	P = Non-P	
	Baseline	CCQ	1.35 (0.70-2.28) v 1.4 (0.85 – 2.20), p = 0.87	P = Non-P	
	3 months	CCQ	1.20 (0.70 – 1.83) v 1 (0.50 – 1.80), p = 0.5	P = Non-P	
	15 months	CCQ	1.3 (0.50 – 2.10) v 1.1 (0.60 – 2.00), p = 0.62	P = Non-P	
			Control Primary Care v Intervention Primary Care		
	Baseline	CRQ	116 (103-125) v 118 (102 – 134), p = 0.85	P = Non-P	
	3 months	CRQ	121 (112 – 131) v 131 (118 – 135), p = 0.2	P = Non-P	
	15 months	CRQ	121 (116-131) v 125 (116 – 135), p = 0.59	P = Non-P	
	Baseline	CCQ	0.7 (0.40 – 1.20) v 0.8 (0.20 – 1.30), p = 0.79	P = Non-P	
	3 months	CCQ	0.7 (0.50 – 0.93) v 0.4 (0.20 – 0.95), p = 0.26	P = Non-P	
	15 months	CCQ	0.5 (0.40 – 1.30) v 0.5 (0.30 – 0.75), p = 1	P < Non-P	

			Control Secondary Care v Secondary Care Intervention	
	Baseline	CRQ	114 (88 – 124) v 107 (102 – 122), p = 0.54	P = Non-P
	3 months	CRQ	106 (78 – 117) v 111 (94 – 121), p = 0.72	P = Non-P
	15 months	CRQ	117 (98 – 130) v 112 (105 – 123), p = 0.65	P = Non-P
	Baseline	CCQ	1.2 (0.80 – 1.70) v 1.4 (0.90 -2.10), p = 0.63	P = Non-P
	3 months	CCQ	1.4 (0.80 – 1.80) v 1.5 (0.85 – 1.95), p = 0.81	P = Non-P
	15 months	CCQ	1.3 (0.90 – 2.08) v 1.2 (0.70 – 1.80), p = 0.83	P = Non-P
			Control Pulmonary Rehab Group v Pulmonary Rehab Intervention Group	
	Baseline	CRQ	90 (77 – 109) v 86 (77 – 98), p = 0.66	P = Non-P
	3 months	CRQ	100 (89 – 117) v 101 (92 – 116), p = 0.93	P = Non-P
	15 months	CRQ	80 (70-98) v 77 (62 – 93), p = 0.85	P = Non-P
	Baseline	CCQ	2.3 (1.45 – 2.90) v 2.15 (1.28 -3.23), p = 0.76	P = Non-P
	3 months	CCQ	1.8 (1.00 – 2.40) v 1.75 (0.98 – 2.30), p = 0.92	P = Non-P
	15 months	CCQ	2.3 (1.60 – 2.90) v 3.1 (2.15 – 3.55), p = 0.25	P = Non-P
Statistical test: Spearman's correlations, statistical significance $p < 0.05$				
Marques 2015	Baseline	SGRQ Total	37.9 (18.2) V 38.3 (17.9), p = 0.94	C = Non-C
		SGRQ		p value calculated using STATA 15

		Symptoms	51 (22.5) v 51.9 (17.8), p = 0.88	C = Non-C	
		SGRQ Activities	53.2 (21.9) v 51.7 (23.2), p = 0.85	C = Non-C	
		SGRQ Impact	23.7 (19.5) v 25.1 (19.2), p = 0.81	C = Non-C	
	Post Intervention	SGRQ Total	31.4 (18.7) v 29.7 (18.4), p = 0.76	C = Non-C	
		SGRQ Symptoms	40.3 (19.4) v 37 (22.6), p = 0.61	C = Non-C	
		SGRQ Activities	43.1 (23.8) v 40.8 (26.3), p = 0.76	C = Non-C	
		SGRQ Impact	18.9 (16.1) v 2- (16.3), p = 0.82	C = Non-C	
Statistical test: Mann-Whitney U tests, statistical significance $p < 0.05$					
Gary 2007	Week 1	MLHFQ	38 (26) v 24 (16), p = 0.14	P = Non-P	p value calculated using STATA 15
	Week 15	MLHFQ	20 (16) v 25 (18), p = 0.48	P = Non-P	
Statistical test: Independent t tests, statistical significance $p < 0.05$					
Azad 2008	Baseline	MLHFQ	**Mean (Range)** 28.66 (0-69) v 23.99 (3-51), p =0.158	C = Non-C	
	Post intervention	MLHFQ	N/R, p = -.47	C = Non-C	

		MOS SF-36	N/R	N/R	
Statistical test: Student's t-test, statistical significance $p < 0.05$					
Doughty 2002	Baseline	MLHFQ Total	50.4 (25.7) v 44.7 (25.3), p = 0.12	P = Non-P	
	12 months	MLHFQ Total	29.5 (22.4) v 28.8 (23.2), p = 0.85	P = Non-P	
	Baseline	MLHFQ Physical	26.6 (12.1) v 24.7 (12.6), p = 0.29	P = Non-P	p value calculated using STATA 15
	12 moths	MLHFQ Physical	14.3 (10.8) v 16.4 (13.4), p = 0.31	P = Non-P	
	Baseline	MLHFQ Emotional	10.8 (7.9) v 9.3 (7.8), p = 0.18	P = Non-P	
	12 months	MLHFQ Emotional	7 (6.9) v 5.3 (5.7), p = 0.12	P = Non-P	
Statistical test: Student's t-test, statistical significance $p < 0.05$					
Deek 2016	Baseline	SF-12 PCS	35(7) v 35 (7), p =0.97	C = Non-C	
	Baseline	SF-12 MCS	46(12) v 48 (12), p = 0.46	C = Non-C	

	30 Days	SF-12 PCS	37.2 (4.7) v 37.4 (4.7), p = 0.77	C = Non-C	
	30 Days	SF-12 MCS	53.9 (12.6) v 54.6 (11.7), p =0.25	C = Non-C	
Statistical test: Student's t-test, statistical significance $p < 0.05$					
Bocchi 2008	Baseline	MLHFQ	57 (15) v 50 (15), p = 0.00	P > Non-P	Baseline score estimated
	12 months	MLHFQ	29 (20) v 39 (22), p = 0.00	P > Non-P	from Figure 4
	36 months	MLHFQ	26 (19) v 29 (18), p = 0.15	P = Non-P	p value calculated from STATA 15
	60 months	MLHFQ	32 (19) v 48 (32), p = 0.00	P > Non-P	
Statistical test: Two-way analysis of variance with repeated measures on time, statistical significance $p < 0.05$					
Hasanpour 2016	Baseline	SF-36	61.01 (14.9) v 62.34 (11.25), p > 0.05	C = Non-C	p values calculated using
	3 months	SF-36	63.34 (12.69) v 58.43 (8.67), p < 0.05	C > Non-C	STATA 15
	Baseline	SF-36 Physical performance	53.2 (8.87) v 52.2 (7.85), p = 0.57	C = Non-C	
	3 months	SF-36 Physical performance	56.12 (10.19) v 49.92 (7.24), p = 0.001	C > Non-C	
	Baseline	SF-36 Activity limitation – emotional problem	66.9 (12.39) v 68.84 (10.3), p = 0.42	C = Non-C	
	3 months	SF-36			

	Activity limitation – emotional problem	57.12 (10.14) v 75.26 (9.26), p = 0	C > Non-C
Baseline	SF-36 Activity limitation – physical problem	56.32 (10.23) v 54.9 (7.71), p 0.45	C = Non-C
3 months	SF-36 Activity limitation – physical problem	52.1 (10.25) v 62.32 (6.2), p = 0	C > Non-C
Baseline	SF-36 Fatigue	54.98 (12.62) v 55.43 (11.67), p = 0.86	C = Non-C
3 months	SF-36 Fatigue	51.78 (16.29) v 60.76 (10.28), p = 0.002	C > Non-C
Baseline	SF-36 Mental Health	61.12 (16.83) v 62.9 (15.68), p = 0.58	C = Non-C
3 months	SF-36 Mental Health	66.56 (15.12) v 61.9 (12.2), p = 0.11	C = Non-C
Baseline	SF-36 Social Performance	65.92 (15.71) v 67.82 (15.68), p = 0.35	C = Non-C
3 months	SF-36 Social Performance	71.89 (16.96) v 67.13 (12.28), p = 0.13	C= Non-C
Baseline	SF-36 Physical pain	70.1 (18.47) v 71.28 (13.55), p = 0.73	C = Non-C
3 months	SF-36 Physical pain	66.12 (16.13) v 78.12 (15.5), p = 0	C > Non-C
Baseline	SF-36		

		General health	74.62 (16.24) v 72.33 (15.5), p =0.49	C = Non-C	
	3 months	SF-36 General health	76.12 (16.13) v 68.12 (15.5), p =0.01	C > Non-C	

Statistical test: Independent and paired t-test., statistical significance $p < 0.05$

Bischoff 2012	Baseline	SGRQ	5.1 (0.94) v 5.26 (0.81), p = 0.34	P = Non-P	p values calculated using STATA 15
	6 months	SGRQ	5.38 (1.79) v 5.45 (1.85), p = 0.84	P = Non-P	
	12 months	SGRQ	5.3 (2.29) v 5.3 (2.14), p = 1	P < Non-P	
	18 months	SGRQ	5.18 (2.18) v 5.5 (1.77), p = 0.39	P = Non-P	
	24 months	SGRQ	5.09 (1.89) v 5.44 (1.57), p = 0.33	P = Non-P	

Statistical test: Generalised estimating equations logistic regression model with compound symmetry to estimate differences in clinically important improvements, statistical significance $p < 0.05$

Jonsdottir 2015	Baseline	SGRQ	35.93 (20.37) v 34.55 (17.81), p = 0.71	C = Non-C	Baseline p value calculated
	Post Intervention	SGRQ	37.32 (19.11) v 36.27 (19.42), p = 0.75	C = Non-C	using STATA 15

Statistical test: Independent group t-test and the Chi-squared test, statistical significance $p < 0.05$

Billington 2014	Baseline	CAT	15.56 (6.8) v 13.94 (7.44), p = 0.34	P = Non-P	Baseline p value calculated using
	12 weeks	CAT	12.44 (6.46) v 13.46 (8.04), p = 0.053* *Adjusted p value. Unadjusted p = 0.021	P = Non-P P > Non-P	STATA 15

Statistical test: Paired t-tests, statistical significance $p < 0.05$

Farquhar 2016	T1	CRQ Dyspnea	3.11 (0.91) v 3.06 (0.92), p = 0.8	C = Non-C	p value calculated using STATA 15
	T2	CRQ Dyspnea	3.35 (0.81) v 3.27 (0.93), p = 0.68	C = Non-C	
	T3	CRQ Dyspnea	3.59 (0.99) v 3.41 (0.99), p = 0.42	C = Non-C	
	T4	CRQ Dyspnea	N/A v 3.6 (1.08). Intervention group completed at this time point. Follow up at T5		
	T5	CRQ Dyspnea	3.86 (1.03) v 3.67 (1.16), p = 0.47	C = Non-C	
	T1	CRQ fatigue	3.15 (0.96) v 2.75 (1.18), p = 0.08	C = Non-C	
	T2	CRQ fatigue	3.44 (1.01) v 2.9 (1.11), p = 0.02	C > Non-C	
	T3	CRQ fatigue	3.27 (0.98) v 3.04 (1.22), p = 0.34	C = Non-C	
	T4	CRQ fatigue	N/A v 3.05 (1.16). Intervention group completed at this time point. Follow up at T5		
	T5	CRQ fatigue	3.73 (0.88) v 3.15 (1.09), p = 0.01	C > Non-C	
	T1	CRQ emotional	3.95 (1.05) v 3.78 (1.18), p = 0.48	C = Non-C	
	T2	CRQ emotional	4.3 (1.11) v 4.06 (1.06), p = 0.32	C = Non-C	
	T3	CRQ emotional	4.42 (1.18) v 4.24 (1.06), p = 0.48	C = Non-C	
	T4	CRQ emotional	N/A v 4.3 (1.3). Intervention group completed at this time point. Follow up at T5		
	T5	CRQ emotional	4.35 (1.11) v 4.49 (1.05), p = 0.58	C = Non-C	
	T1	CRQ mastery	3.87 (1.28) v 3.9 (1.33), p = 0.91	C = Non-C	

	T2	CRQ mastery	4.43 (1.29) v 4.02 (1.25), p = 0.15	C = Non-C	
	T3	CRQ mastery	4.49 (1.35) v 4.23 (1.16), p = 0.36	C = Non-C	
	T4	CRQ mastery	N/A v 4.42 (1.29). Intervention group completed at this time point. Follow up at T5		
	T5	CRQ mastery	4.71 (1.1) v 4.69 (1.13), p = 0.94	C = Non-C	
	2 wks.	EQ-5D	0.49 (N/R) v 0.55 (NR), p = N/R	N/R	
	4 wks.	EQ-5D	0.58 (N/R) v 0.58 (NR), p = N/R	N/R	
	6 wks	EQ-5D	0.59 (N/R) v 0.54 (N/R), p = N/R	N/R	

Statistical test: Intention-to-treat analyses using a linear regression model, statistical significance $p < 0.05$

Kalter-Leibovici 2017	Baseline	SF36 Physical	**Median (IQR)** 38 (27 - 53) v 41 (30 - 54), p = 0.1	P = Non-P	p value calculated using
		SF36 Mental	46 (37 - 58) v 48 (38 - 58), p = 0.13	P = Non-P	STATA 15
	6 months	SF36 Physical	45 (32 - 61) v 45 (32 - 62), p = 1	P < Non-P	
		SF36 Mental	51 (40 - 63) v 48 (38 - 62), p = 0.11	P = Non-P	
	12 months	SF36 Physical	46 (33 - 63) v 46 (32 - 61), p = 1	P < Non-P	
		SF36 Mental	52 (40 - 64) v 50 (39 - 62), p = 0.31	P = Non-P	

18 months	SF36 Physical	47 (32 - 64) v 47 (33 - 61), p = 1	P < Non-P
	SF36 Mental	51 (40 - 64) v 52 (40 - 64), p = 0.64	P = Non-P
24 months	SF36 Physical	46 (32 - 63) v 44 (32 - 61), p = 0.49	P = Non-P
	SF36 Mental	53 (41 - 65) v 50 (39 - 64), p = 0.21	P = Non-P
30 months	SF36 Physical	43 (31 - 64) v 46 (31 - 64), p = 0.42	P = Non-P
	SF36 Mental	50 (40 - 63) v 49 (40 - 64), p = 0.71	P = Non-P
36 months	SF36 Physical	46 (33 - 65) v 46 (32 - 65), p = 1	P < Non-P
	SF36 Mental	56 (43 - 65) v 52 (41 - 67), p = 0.21	P = Non-P
42 months	SF36 Physical	47 (32 - 65) v 48 (31 - 67), p = 0.85	P = Non-P
	SF36 Mental	53 (42 - 65) v 53 (41 - 67), p = 1	P < Non-P
48 months	SF36		

		Physical	48 (28 - 67) v 52 (37 - 65), p = 0.58	P = Non-P
		SF36 Mental	52 (38 - 66) v 55 (44 - 66), p = 0.52	P = Non-P
	54 months	SF36 Physical	46 (31 - 74) v 45 (40 - 68), p = 0.94	P = Non-P
		SF36 Mental	55 (46 - 69) v 54 (45 - 67), p = 0.91	P = Non-P

Statistical test: Dichotomously categorized to represent a minimal clinically important difference from baseline, (≥2.5 points increase), non-liner mixed models with random intercept to demonstrate treatment OR.

Srisuk 2016	Baseline	MLHFQ	50.2 (2.5) v 53 (2.5) **Mean difference (CI)** -2.8 (-7.8, 2.1), p = 0.255	C = Non-C
	3 months	MLHFQ	50.3 (2.2) v 53 (2.2) **Mean difference (CI)** -2.7 (-7.1, 1.6), p = 0.221	C = Non-C
	6 months	MLHFQ	52 (2) v 55 (2) **Mean difference (CI)** -3.0 (-7.1, 1.0), p = 0.139	C = Non-C
	Baseline	MLHFQ Emotional	11.8 (0.9) v 12 (0.9) **Mean difference (CI)** -1.2 (-2.9, 0.5), p = 0.173	C = Non-C
	3 months	MLHFQ Emotional	11.5 (0.7) v 13.2 (0.7) **Mean difference (CI)**	

			-1.7 (-3.0, - 0.3), p = 0.014		C > Non-C	
	6 months	MLHFQ	12.1 (0.6) v 13.6 (0.6) **Mean difference (CI)** -1.5 (-2.8, -0.3), p = 0.015		C > Non-C	
	Baseline	MLHFQ Physical	19.8 (1.1) V 19.9 (1.1) **Mean difference (CI)** -0.1 (-2.2, 2.0), p = 0.925		C = Non-C	
	3 months	MLHFQ Physical	52.1 (1.5) v 49.3 (1.5) **Mean difference (CI)** 0.0 (-2.0, 2.0), p = 0.991		C = Non-C	
	6 months	MLHFQ	19.6 (0.9) v 20 (0.9) **Mean difference (CI)** -0.4 (-2.2, 1.4), p = 0.683		C = Non-C	
Statistical test: T-test and effect size, between group difference over time analysed using a linear mixed effects model, statistical significance $p < 0.05$						
Clark 2015	Time 1	KCCQ Physical Limitations	54.10 (27.22) v 62.23 (28.25)			
	Time 2	KCCQ Physical Limitations	59.1 (28.2) v 61.78 (27.28)			
	Time 3	KCCQ Physical Limitations	61.28 (26.93) v 60 (27.18)			
	Time 4	KCCQ Physical Limitations	58.6 (27.4) v 64.58 (25.27)	p = 0.367	P = Non-P	P value = time x group
	Time 1	KCCQ Total symptom score	60.92 (27.53) v 64.42 (24.37)			

Time 2	KCCQ Total symptom score	71.88 (21.38) v 65.38 (25.23)		
Time 3	KCCQ Total symptom score	70.58 (23.27) v 66.33 (26.95)		
Time 4	KCCQ Total symptom score	64.08 (24.31) v 63.96 (26.98)	p = 0.427	P = Non-P
Time 1	KCCQ Self-efficacy subscale	73 (24.12) v 81 (17.35)		
Time 2	KCCQ Self-efficacy subscale	94.5 (8.9) v 88.5 (13.46)		
Time 3	KCCQ Self-efficacy subscale	92 (12.44) v 87.5 (13.5)		
Time 4	KCCQ Self-efficacy subscale	93 (11.46) v 86.5 (16.5)	p = 0.028	P > Non-P
Time 1	KCCQ QoL subscale	53.82 (28.34) v 63.67 (26.99)		
Time 2	KCCQ QoL subscale	71.53 (21.27) v 63.67 (25.1)		
Time 3	KCCQ QoL subscale	68.4 (24.69) v 65.33 (28.63)		
Time 4	KCCQ QoL subscale	69.79 (23.67) v 55.67 (31.71)	p = 0.018	P > Non-P

	Time 1	KCCQ Social limitation subscale	59.15 (29.03) v 65.34 (25.87)		
	Time 2	KCCQ Social limitation subscale	69.93 (27.29) v 60.89 (24.83)		
	Time 3	KCCQ Social limitation subscale	66.67 (28.5) v 56.16 (26.84)		
	Time 4	KCCQ Social limitation subscale	61.78 (26.26) v 57.77 (28.33)	p = 0.072	P = Non-P
	Time 1	KCCQ Overall summary scores	55.38 (23.98) v 63.08 (22.9)		
	Time 2	KCCQ Social limitation subscale	67.23 (20.69) v 61.82 (21.13)		
	Time 3	KCCQ Social limitation subscale	65.77 (21.6) v 61.53 (24.16)		
	Time 4	KCCQ Social limitation subscale	62.61 (21.8) v 60.43 (24.12)	p = 0.035	P > Non-P

Statistical test: Repeated measures analysis of variance (ANOVA), statistical significance $p < 0.05$

Martensson 2005	Between group differences Baseline to 3 months	SF36 Physical Component scale	-3 (NR), p = NR		
		SF36 Physical functioning	-5.5 (NR), p = NR		

	SF36 Role – physical	-22 (1.44), p = 0.008	C > Non-C
	SF36 Bodily pain	-5 (NR), p = NR	
	SF36 General health	-5.1 (NR), p= NR	
	SF36 Mental component scale	-5 (NR), p = NR	
	SF36 Vitality	-6.7 (3.46), p = 0.051	C = Non-C
	SF36 Social functioning	-10 (2.275), p = 0.056	C = Non-C
	SF36 Role – emotional	-21.3 (NR), p = NR	
	SF36 Mental health	-0.5 (NR), p = NR	
Between group differences Baseline to 12 months	SF36 Physical Component scale	-1.5 (NR), p = NR	
	SF36 Physical functioning	-6.5 (NR), p = NR	
	SF36 Role physical	-5.4 (NR), p = NR	

	SF36 Bodily pain	-2.5 (NR), p = NR
	SF36 General health	-2.6 (NR), p = NR
	SF36 Mental component scale	-2.5 (NR), p = NR
	SF36 Vitality	-3 (NR), p = NR
	SF36 Social functioning	-7.5 (NR), p = NR
	SF36 Role emotional	-14.5 (NR), p = NR
	SF36 Mental health	-1.6 (NR), p = NR
Within group differences Baseline to 3 months	MLHFQ Physical health	-2.3 (NR) v -0.3 (NR), p = NR
	MLHFQ Emotional scale	-0.9 (NR) v 0.2 (NR), p = NR
	MLHFQ Total	-3.2 (NR) v 1.5 (NR), p =NR
Within group Difference Baseline to 12 months	MLHFQ Physical health	-0.1 (NR) v 0.5 (NR), p = NR

		MLHFQ Emotional scale	-0.1 (NR) v 0.1 (NR), p = NR		
		MLHFQ Total	-2.1 (NR) v 2.9 (NR), p = NR		

Statistical test: Student's t test, Wilcoxon matched pairs text for within group comparison, statistical significance $p < 0.05$

Andryukhin 2010	Baseline	MLHFQ Total	**Median (IQR)** 54.5 (44-59) v 58 (49-65), p = 0.44	P = Non-P	
	Baseline	MLHFQ Physical	22.5 (18-25) v 23 (20-27), p = 0.8	P = Non-P	p value calculated using STATA after imputing mean & SD
	Baseline	MLHFQ Emotional	7 (7-11) v 11 (9-14), p = 0	P > Non-P	
	6 months	MLHFQ Total	44.5 (15-47) v 61 (55 -70), p = 0	P > Non-P	
	6 months	MLHFQ Physical	18 (15 -21) v 26 (21-28), p = 0	P > Non-P	
	6 months	MLHFQ Emotional	6 (5-9) v 13 (10 – 15), p = 0	P > Non-P	

Statistical test: Mann Whitney *U* test, statistical significance $p < 0.05$

Witham 2015	Baseline	EQ-5D	**Median (IQR)** 0.73 (0.23) v 0.76 (0.24)		
	Week 8	EQ-5D	NR		

	Week 24	EQ-5D	NR		
	Baseline	MLHFQ	15 (22) v 8 (12)		
	Week 8	MLHFQ	NR		
			Mean (SD)		
	Week 24	MLHFQ	13.4 (10.2) v 13.3(10.2), p = 0.96	C = Non-C	0.96 calculated using STATA 15
			Mean difference (CI)		
	Change between Baseline to 8 weeks	EQ-5D	0.08 (-0.02 to 0.17), p = 0.11	C = Non-C	
	Baseline to 24 weeks	EQ-5D	0.07 (-0.03 to 0.16), p = 0.15	C = Non-C	
	Change between Baseline to 8 weeks	MLHFQ	1.4 (-1.9 to 4.7), p = 0.41	C = Non-C	
		MLHFQ	0.1 (-4.4 to 4.6), p = 0.95	C = Non-C	

Statistical test: Intention to treat analysis, ANOVA analysis to compare change in scores, statistical significance $p < 0.05$

Rich 1995	Baseline	Chronic HF Questionnaire	72.1 (15.6) v 74.4 (16.3), p = 0.42	P = Non-P	
	90 days	Chronic HF Questionnaire	94.3 (21.3) v 85.7 (19), p = 0.01	P > Non-P	p value calculated using STATA 15
	Baseline	Chronic HF Questionnaire Dyspnea subscale	9 (7.9) v 8.1 (7.7), p = 0.51	P = Non-P	
	90 days	Chronic HF Questionnaire Dyspnea subscale	15.8 (12.8) v 11.9 (10), p = 0.06	P = Non-P	

	Baseline	Chronic HF Questionnaire Fatigue	12.9 (5.3) v 14.1 (5.6), p = 0.21	P = Non-P	
	90 days	Chronic HF Questionnaire Fatigue	18.3 (6.3) v 16.8 (5.5), p = 0.15	P = Non-P	
	Baseline	Chronic HF Questionnaire Emotional function	31.9 (8.5) v 33.3 (8.1), p = 0.34	P = Non-P	
	90 days	Chronic HF Questionnaire Emotional function	37.4 (7.8) v 35.2 (8.4), p = 0.13	P = Non-P	
	Baseline	Chronic HF Questionnaire Environmental mastery	18.3 (5.8) v 18.9 (4.8), p = 0.53	P = Non-P	
	90 days	Chronic HF Questionnaire Environmental mastery	22.7 (4.9) v 21.7 (4.6), p = 0.24	P = Non-P	
Statistical test: Student's t-test (normally distributed data) Wilcoxon rank-sum test (non-normal distributed data), statistical significance $p < 0.05$					
Cline 1998	Baseline	Quality of life in HF	4.5 (1) v 4.2 (1.1), p = 0.005	C > Non-C	
	One year	Quality of life in HF	3.5 (1.3) v 3.5 (1.1), p = 1	C < Non-C	p value calculated using STATA 15
	Baseline	Nottingham Health profile	30.1 (21.6) v 26.9 (21.2), p = 0.309	C = Non-C	
	One year	Nottingham Health profile	25.3 (22.2) v 23.4 (22.2), p = 0.62	C = Non-C	
	Baseline	MLHFQ	4.3 (1.5) v 3.7 (1.6), p = 0.009	C > Non-C	

One year	MLHFQ	3.3 (1.4) v 3.2 (1.6), p = 0.7	C = Non-C

Statistical test: Two tailed t test (normally distributed data), Mann-Whitney *U* test (non-normal distributed data) statistical significance $p < 0.05$

Categorisation of effect:
C = Non-C: Patient and caregiver intervention group is equal to patient and caregiver control group = 115 (85%)
C > Non-C: Patient and caregiver intervention group statistically superior = 18 (13%)
C < Non-C: Patient and caregiver control group statistically superior = 3 (2%)

P = Non-P: Patient intervention group is equal to patient control group = 83 (80%)
P > Non-P: Patient intervention group statistically superior = 13 (13%)
P < Non-P: Patient control group statistically superior = 7 (7%)

Abbreviations:
Pt. – patient
Cg. – caregiver
SD – Standard Deviation
I - intervention
C – Control
MLHHFQ – Minnesota Living with Heart Failure Questionnaire
SF-36 – Short Form 36
SF-PCS – Short Form Physical Component Scale
SF-MCS – Short Form Mental Component Scale
SF-36 -PF – Short Form Physical Functioning
SF-36-RP – Short Form 36 Role Physical
SF-36-BP – Short Form 36 Bodily Pain
SF-36-GH – Short Form 36 General Health
SF-36-VT – Short Form 36 Vitality
SF-36-SF – Short Form 36 Social Functioning
SF-36-REShort Form 36 Role Emotional
SF-36-MH – Short Form 36 Mental Health
KCCQ – Kansas City Cardiomyopathy Questionnaire

CRQ – Chronic Respiratory Questionnaire
CCQ – Clinical COPD Questionnaire (COPD – Chronic Obstructive Pulmonary Disease)
SGRQ – St. Georges Respiratory Questionnaire
N/R – Not reported
MOS SF-3F – Medical Outcomes Study Short Form 36
SF-12 PCS – Short Form 12 Physical Component Scale
SF-12 MCS - Short Form 12 Mental Component Scale
CAT – COPD Assessment Test
T1 – Time 1, T2 – Time 2, T3 – Time 3, T4 – Time 4
N/A – Not applicable
Wks – weeks
EQ-5D – EuroQol measure
HF – Heart Failure

Search Strategy

Vertical Use: "OR"	**Population (Diagnosis)**	**Intervention**	**Deign**
	Heart OR Cardiac OR Myocardial AND failure.ti,ab	(Self-management AND (education OR information OR advice OR rehabilitation* OR program* OR health OR design))	Randomized AND controlled AND trial OR randomised AND controlled AND trial
	Left OR Right ventricular AND failure.ti,ab	((rehabilitati* or educat*) AND (literature or audiovisual or av or audio visual or internet or web* or telecare or telemedicine or telephone* or phone* or teleconference* or telehealth or podcast* or email* or e-mail*))	Controlled AND clinical AND trial
	Heart OR Cardiac OR Myocardial AND incompetence*	((educat* or intervent*) AND (communit* or nurs* OR health OR rehabilitation))	
	Cardiac OR Myocardial AND insufficiency	Evidence-based AND intervention	
	Systolic OR Diastolic AND failure	(education AND (service* OR group* OR program* OR session))	
	Chronic Obstructive Pulmonary Disease.ti,ab	Self-management AND (intervention OR therap*)	
	Dysp*	(health AND (management OR behaviour*))	
	airway* OR airflow* AND disease OR disorder	Group AND intervention	
	respiratory AND disease OR disorder	(Palliative care) AND intervention	
	chronic airflow obstruction		

	Pulmonary OR respiratory AND disease*.ti,ab		
	MeSH: Heart Failure (MAJOR CONCEPT), Chronic Obstructive Pulmonary Disease (Major Concept)	MeSH: Health Education (MAJOR CONCEPT) Self-management Rehabilitation (Major concept)	

ABSTRACT

Aim Quantify the impact of involving caregivers in self-management interventions on health-related quality of life (HRQoL) of patients with heart failure (HF) or chronic obstructive pulmonary disease (COPD).

Design Systematic review, meta-analysis.

Data sources Searched: Medline Ebsco, PsycINFO, CINAHL, Embase, Web of Science, The British Library and ProQuest.

Review Methods Randomised controlled trials involving caregivers in self-management interventions (≥2 components) compared to usual care for patients with HF or COPD. A matched sample based on publication year, geographic location, and inclusion of an exercise intervention of studies not involving caregivers were identified. Primary outcome of analysis was patient HRQoL.

Results 13 RCT's (1,701 participants: 1,439 HF; 262 COPD) involving caregivers (mean age 59; 58% female) were identified. Reported patient HRQoL measures included; Minnesota Living with Heart Failure questionnaire, St. George's respiratory questionnaire and Short-Form-36. Compared to usual care, there was similar magnitude in mean improvement in patient HRQoL with self-management interventions in trials involving caregivers (mean standardised mean difference (SMD): 0.23, 95% confidence interval: -0.15 to 0.61) compared to trials without caregivers (SMD: 0.27, 0.08 to 0.46).

Conclusion Within the methodological constraints of this study, our results indicate that involving caregivers in self-management interventions does not result in additional improvement in patient HRQoL in HF or COPD. However, involvement of caregivers in intervention delivery remains an important consideration and key area of research.

Impact Greater understanding and awareness is needed of the methodology of caregiver engagement in intervention development and delivery and its impact on patient outcomes.

Keywords Caregivers, heart failure, chronic obstructive pulmonary disease, self-management, interventions, meta-analysis, systematic review,

INTRODUCTION

Behaviour change and psychological coping theories frequently inform the development of psychosocial interventions. Such interventions are particularly relevant in the domain of self-management for individuals with chronic conditions; enabling individuals with long term conditions to live with and manage the signs and symptoms of their illness (Grady & Gough, 2014). As healthcare systems experience increasing financial pressures, the development of alternative strategies for the sustainability of the delivery of self-management programmes is needed (Rotheram-Borus, Ingram, Swendeman, & Lee, 2012). Patients are relying more on unpaid caregivers (families/friends) to support them in their self-management. (Carers Trust, 2015). Older caregivers compared with non-caregivers experience more depression, stress and poorer subjective well-being (Pinquart & Sörensen, 2003). Physical and mental health deterioration of the caregiver leads to disengagement from the caregiving role. This can be detrimental for both the patient and caregiver (Pearlin, Mullan, Semple, & Skaff, 1990). Caregivers have a variety of needs which may impede their ability to provide care for patients (Wingham, et al., 2015; Wingham, Frost, & Britten, 2017) creating worries about the future when they can no longer provide care (Simpson, Young, Donahue, & Rocker, 2010). Caregivers of HF and COPD patients are experiencing an increasing reliance to provide support (Kennedy, et al., 2017; Nakken, et

al., 2015). However, there is a gap in the knowledge base examining the impact of involving caregivers in the delivery of intervention on patient outcomes.

A meta-analysis of randomised controlled trials (RCTs) examining the benefits of family member involvement in psychosocial interventions demonstrated positive outcomes for patients on depression and mortality and positive outcomes for caregivers in reducing burden, anxiety and depression. However, the aggregate effect of these outcomes were small in magnitude (Martire, Lustig, Schulz, Miller, & Helgeson, 2004). Hartmann, Bäzner, Wild, Eisler and Herzog (2010) conducted a meta-analysis of family involvement in the treatment of chronic illness (cardiovascular disease and arthritis) interventions for physical conditions. They concluded, family involvement in interventions resulted in significantly better patient and family members' physical and mental health compared to standard care. However, research into patient-partner dyads in self-management interventions for chronic disease is limited (Bryant, et al., 2016) and findings are inconsistent, especially with regards to how caregivers should best be involved in delivery of such interventions. A mixed methods study examining the perception of rehabilitation one-year post stroke for patients and their caregivers emphasised that researchers should take a broader perspective and research the patient-partner dyad which can increase the understanding of the wider complex external factors in patient's rehabilitation (Ekstam, Johansson, Guidetti, Eriksson, & Ytterberg, 2015). In order to develop the efficacy of family involvement, research should focus on illness specific populations, interventions with long-term follow up, greater specificity on the extent of family member engagement and description of theoretical basis and selection of outcome measures (Caress, Luker, Chalmers, & Salmon, 2009; Martire, et al., 2004).

Conceptual underpinnings in family focused interventions for patients with heart failure (HF) are not explicit in HF and caregiver intervention development (Deek, et al., 2016). Similarly, Bryant and colleagues reported similar when examining intervention studies involving caregivers in chronic obstructive pulmonary disease (COPD) (Bryant, et al., 2016). They emphasise the methodology of caregiver involvement is poorly described and there is a greater need for theoretically based interventions in testing the effectiveness of interventions.

BACKGROUND

A diagnosis of HF or COPD is a life-changing event (Barnett, 2005; Jeon, Kraus, Jowsey, & Glasgow, 2010). Both are long term, life-limiting conditions; characterised by significant physical impact on one's life including breathlessness, fatigue, chest tightness, and reduced ability to exercise (Agusti, 2007; Britton, 2003; Ponikowski, et al., 2016). It is estimated at least 26 million people worldwide live with HF (Savarese & Lund, 2017) and 65 million people globally are living with moderate to severe COPD (Mathers & Loncar, 2006). Approximately 19% of patients with COPD are diagnosed with HF (Conrad, et al., 2017), whilst approximately 35% of patients with HF are diagnosed with COPD (Lainscak & Anker, 2015). Both conditions can be self-managed with medication and lifestyle adaptations. Researchers and policy makers are advocating rehabilitation interventions which combine HF and COPD (Man, et al., 2016). An exercise rehabilitation programme trialled with both HF and COPD patients demonstrated that combining an exercise programme for these conditions was effective (Evans, et al., 2010). Support has been identified as a key component for patients to be successful in their self-management (Dwarswaard, Bakker, van Staa, & Boeije, 2016).

Supporters of patients such as unpaid caregivers are important contributors to HF and COPD self-care (Bove, Zakrisson, Midtgaard, Lomborg, & Overgaard, 2016; Vellone, et al., 2015) and should be

included in the process when providing interventions for people with HF or COPD (Clark, et al., 2014; Gardiner, et al., 2010; Jaasrsma, Cameron, Riegel, & Stromberg, 2017; Mi, et al., 2017). The United Kingdom National Institute for Health and Care Excellence (NICE) clinical guidelines for HF (NG106) and COPD (NG115) advocate the inclusion of family members/caregivers in health care discussions and in rehabilitation. A Cochrane review of interventions supporting caregivers in the terminal phase of illness recommend further research to assess interventions on the health of caregivers (Candy, Jones, Drake, Leurent, & King, 2011).

Qualitative research has highlighted the needs and important contributions of HF and COPD caregivers to patient self-management (Bergs, 2002; Piamjariyukal, Smith, Werkowitch, & Elyachar, 2012; Simpson, et al., 2010; Wingham, et al., 2015). There is a paucity of quantitative evidence as to whether involving caregivers in self-management interventions positively impacts on HF or COPD patient's outcomes; particularly health related quality of life (HRQoL). HRQoL is important to measure due to the long term, enduring nature of these conditions. Engagement with both pulmonary and cardiac rehabilitation have demonstrated positive improvements in patient HRQoL (Casaburi, 2018; Sagar, et al., 2015). Existing evidence is conflicting regarding the success of the intervention and lacks clarity about the extent of the involvement of caregivers and the methodological rigour (Bryant et al., 2016; Buck et al., 2018; Evangelista, Strömberg, & Dionne-Odom, 2016). A review of self-management approaches for people with chronic conditions indicates that there is a gap in the literature with regard to caregivers and self-management interventions (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002). If we are to facilitate effective self-management interventions for patients with HF and COPD we need a greater understanding of the effects of caregivers with this population.

THE REVIEW

Aims

The aims of this systematic review and meta-analysis of RCTs that involve caregivers in the delivery of self-management interventions for patients with HF or COPD are to: (1) assess methodology used by researchers to involve caregivers; (2) quantify the impact on patient HRQoL; (3) compare the magnitude of impact on patient HRQoL of RCTs that do versus those that do not involve caregivers in the delivery of self-management interventions; and (4) examine the impact on the HRQoL of caregivers.

Design

This systematic review and meta-analysis was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses PRISMA statement (Moher, Liberati, Tetzlaff, & Altman, 2009). The protocol for this review was published on Prospero; international prospective register of systematic reviews. ID number CRD 42018090748.

Search methods

Our search strategy was designed in conjunction with experienced Information Specialists. Search terms included condition specific terms, i.e., "heart failure", and "chronic obstructive pulmonary disease" and intervention related terms "self-management" and "education" (see online supplementary file for a full list of search terms). Databases searched included: Medline Ebsco, PsycINFO, CINAHL Plus with Full Text, Embase, Web of Science, The British Library and ProQuest. Grey literature was identified using Global Dissertations and Theses and Applied Sciences Index and hand searches and citation checking of included references. To ensure the contemporary nature of the

evidence considered, the search time frame was January 1990 to 30th March 2018. A single researcher (MN) initially screened titles and abstracts. Selection of full papers was performed by two researchers (MN and RST) and cross checked with the eligibility criteria.

Search outcome

Studies were included if they met the following criteria:

(1) Study design: RCTs (including individual or cluster designs).
(2) Population adults (≥ 18 years) with HF or COPD.
(3) Intervention: Self-management intervention programmes which were comprised of two or more intervention components (e.g. exercise, education, support and psychotherapeutic elements). The self-management interventions either formally included caregivers in the delivery of the intervention compared to usual care or did not involve caregivers in the delivery of the intervention compared to usual care. We classified formal inclusion of caregivers as; caregivers being explicitly included as participants in the intervention.
(4) Outcomes: Patient and caregiver HRQoL.

We excluded: (1) studies in long term residential care setting; (2) studies where caregivers were not explicitly part of the intervention delivery.

In order to compare HRQoL outcomes of studies involving caregivers in intervention delivery and studies that did not involve caregivers in intervention delivery we employed a quasi-randomised sampling strategy. A matching strategy was undertaken to minimise potential differences between studies i.e. comparison of intervention studies involving patients only versus intervention studies involving both patient and caregiver. Studies not involving caregivers were first listed in alphabetical order and were then matched with the caregiver studies. Four study level criteria; which were consistently reported across all trials were pragmatically chosen for matching: (1) patient diagnosis (HF or COPD), (2) geographical location (Europe, North America, or other), (3) year of publication (pre or post 2000), and (4) inclusion of exercise as a key intervention component.

Quality Appraisal

The Cochrane Risk of Bias Tool (Higgins, Savović, Page, & Sterne, 2018) was used to determine the methodological quality of included studies. Study authors were contacted by MN if any required data was missing for meta-analysis. Data extraction and risk of bias assessment were initially conducted by one reviewer (MN) and revised by a second reviewer (RST). Any disagreements were resolved through discussion and reaching consensus.

Data Abstraction

A standardised data extraction form was used to extract details on the study, population, intervention, HRQoL outcome measures at all time points and the author's conclusion. Studies with multiple publications were all reviewed and data was extracted into a single data extraction form. A bespoke data extraction tool was developed guided by the Medical Research Council guidelines for complex interventions (Craig, et al., 2006) and the TiDier checklist (Hoffman, et al., 2014).

Synthesis

Results of this systematic review are presented descriptively in the form of detailed tabular summaries and a quantitative synthesis of patient HRQoL outcomes using both meta-analysis and a vote counting approach.

All relevant data available for included studies were pooled for statistical meta-analysis using Review Manager 5.3 (Rev Man V.5.3, The Cochrane Collaboration). Given the variation in HRQoL outcomes reported across studies, between group outcomes were expressed across studies as standardised mean differences (SMD). That is, the results of studies are standardized to the same scale in order to combine them. The weight of the intervention effect is expressed comparatively to the variability identified in the study (Higgins & Green, 2011). Studies were pooled using random effects meta-analysis due to the clinical heterogeneity of included studies. Meta-analysis was conducted by pooling total HRQoL score at the latest point of follow up. In studies reporting more than one HRQoL measure, the primary HRQoL measure was used (or if primacy was not stated, the outcome measure described first in the methods section of the study was utilised). We undertook a sensitivity analysis excluding COPD studies. Data was presented descriptively using tables to summarise and synthesise the findings. Meta-analysis results were reported as means and 95% confidence intervals (CIs). Missing data was imputed when possible using STATA V.15.

Given that all studies did not report HRQoL data that could be included in meta-analysis we also undertook a vote counting assessment of HRQoL outcomes across all included studies. That is; quantitatively categorising all studies according to existence of a statistically significant ($P \leq 0.05$) effect on HRQoL between intervention and control groups (Higgins & Green, 2011). The advantage of the vote counting method (over meta-analysis) is that it allows inclusion of studies irrespective of their method of quantitative reporting of outcomes. As a sensitivity analysis, we compared the conclusions of vote-counting to our meta-analysis.

RESULTS

Study selection process

Following removal of duplicates the search strategy yielded a total of 16,183 title and abstracts. Of these, 602 full papers were reviewed. This resulted in 13 studies involving caregivers for synthesis. Therefore, 13 matched studies not including caregivers were retained for comparative meta-analysis. The study selection process is summarised in a PRISMA Flow diagram shown in Figure 1.

Three pairs of studies did not meet all four criteria for this sampling strategy, and were instead matched on diagnosis, year, exercise as a key element of the intervention and HRQoL. The matched sampling strategy can be viewed online.

Figure 1 – PRISMA

Characteristics of included caregiver studies

We synthesised thirteen studies (14 publications) which involved caregivers in the delivery of the intervention (Ågren, Berg, Svedjeholm, & Strömberg, 2015; Ågren, Evangelista, Hjelm, & Strömberg, 2012; Azad, Molnar, & Byszewski, 2008; Cline, Israelsson, Willenheimer, Broms, & Erhardt, 1998; Deek et al., 2017; Farquhar, et al., 2016; Hasnapour-Dehkordi, Kahledi-Far, Khaledi-Far, & Salehi-Tali, 2016; Jonsdottir, et al., 2015; Liljeroos, Ågren, Jaarsma, Årestedt, & Strömberg, 2015; Mårtensson, Strömberg, Dahlström, Karlsson, & Fridlund, 2005; Marques, et al., 2015; Naylor, et al., 2004; Srisuk, Cameron, Ski, & Thompson, 2017; Witham, et al., 2012). A summary of the characteristics of all 26

studies is shown in Table 1. All detailed summary of all included studies can be accessed via an online supplementary file.

Table 1 - Characteristics of studies

Risk of Bias

A summary of risk of bias assessment in caregiver included studies is shown in Table 2. Studies were of mixed quality and often poorly reported. The methodological issues most often classified as high risk were: blinding of participants/personnel (n = 12) and incomplete reporting of data (n = 6). The majority of studies were judged to be at low risk for random sequence generation (n = 12) and baseline balance (n=13). Details of risk of bias assessment for all 26 studies can be accessed via an online supplementary file.

Table 2 – Risk of Bias Assessment

Methodology of caregiver involvement

Table 3 describes the intervention components of these studies. The predominant method of caregiver involvement was face to face (10/13 studies; 77%) with health professional and the person they were providing care for (Ågren, et al., 2015; Ågren, et al., 2012; Azad, et al., 2008; Deek, et al., 2017; Hasnapour-Dehkordi, et al., 2015; Farquhar, et al., 2016; Srisuk, et al., 2017; Mårtensson, et al., 2005; Cline, et al., 1998). Four studies (31%) utilised group sessions as a component of the intervention (Azad, et al., 2008; Marques, et al., 2015; Jonsdottir, et al., 2015; Witham, et al., 2012). One study (8%) specifically reported that caregivers were invited to share their experiences (Ågren, et al., 2015). Addressing family or caregiver needs was referred to as a component of the intervention in seven (54%) studies (Ågren, et al., 2015; Ågren, et al., 2012; Naylor, et al., 2004; Marques, et al., 2015; Azad, et al., 2008; Witham, et al., 2012; Farquhar, et al., 2016). In two (15%) studies caregivers only, participated in a part of the intervention; an educational section (Witham, et al., 2012); and counselling sessions and educational session on understanding heart failure (Azad, et al., 2008). Three (23%) studies described the theoretical underpinnings in the intervention development (Ågren, et al., 2012; Deek, et al., 2017; Srisuk, et al., 2017):

1) Concept model based on Stuifbergen and Pender's model of health promotion and Bandura's self-efficacy theory (Agren, et al., 2012).
2) Behaviour change in adults, Behaviour change wheel. Behaviour change interventions. Middle range theory of self-care of chronic illness. Orem's self-care theory. The situation specific theory of heart failure self-care (Deek, et al., 2017).
3) Adult learning theory and teach back method (Srisuk, et al., 2017).

The remainder reported their intervention development in the following formats; best practice clinical guidelines (Mårtensson, et al., 2005; Farquhar, et al., 2016; Naylor, et al., 2004), conducting a literature review (Marques, et al., 2015), focus group involving family members (Hasanpour-Dekhordi, et al., 2016), previous use of the intervention (Witham, et al., 2012; Jonsdottir, et al., 2015) and previous qualitative research (Ågren, et al., 2015). The two studies which demonstrated the greatest gains in patient HRQoL compared to usual care were both face to face and multidisciplinary in their delivery with multi-component hard copy materials provided for patients (Hasanpour-Dehkordi, et al., 2016; Srisuk, et al., 2017). Both studies were conducted in middle income countries (Iran and Thailand)

respectively. Intervention development was based on theory; adult learning theory (Srisuk, et al., 2017) or informed by focus groups involving patient and caregivers (Hasanpour-Dehkordi, et al., 2016).

Table 3 – Intervention components of studies involving caregivers

Meta-analysis

Impact on patient HRQoL of self-management interventions involving caregivers

(1) Meta-analysis

Seven studies that involved caregivers provided total HRQoL score that could be included in a meta-analysis. Outcome measures used included both disease specific measures (i.e. Minnesota Living with Heart Failure questionnaire, St. George's respiratory questionnaire) and generic measures (Short-Form-36). Whilst there was evidence of higher patient HRQoL with intervention compared to usual care control (mean standardised mean difference (SMD): 0.23, 95% CI: -0.15 to 0.61), this failed to reach statistical significance (P = 0.24). There was evidence of a high level of statistical heterogeneity seen across studies (I^2 = 83%). A sensitivity analysis was conducted to examine caregiver included studies of HF patients only. This did not alter the interpretation of the results (mean standardised mean difference (SMD): 0.34, 95% CI: -0.16 to 0.85, P = 0.19, I^2 = 88%). This sensitivity analysis can be viewed online.

Figure 2 – Forest plot of caregiver included studies

Another sensitivity analysis was conducted which included studies reporting SF-36 physical and mental component subscales (PCS and MCS) (Ågren, et al., 2015; Deek, et al., 2017). Results remained consistent with the primary meta-analysis i.e. PCS inclusion: SMD: 0.25, 95% CI: -.0.10 to 0.61 (P = 0.16) (see online supplementary file) and MCS inclusion: SMD: 0.19, 95% CI: -0.10 to 0.49 (P = 0.20) (see online supplementary file). Again a high level of statistical heterogeneity was seen (both I^2 = 79%)

(2) Vote counting

A number of included studies reported >1 HRQoL domains giving a total of 136 HRQoL intervention vs controls. The results of vote counting were consistent with the meta-analysis in that only 18 (13%) intervention vs control comparisons showed statistical superiority (P<0.05) of the intervention compared to control.

Impact on HRQoL of self-management interventions not involving caregivers

(1) Meta-Analysis

We were able to include HRQoL data in a meta-analysis from 12 studies that did not involve caregivers in intervention delivery. In addition to the outcome measures reported in the previous meta-analysis; patient only studies also utilised the Kansas City Cardiomyopathy questionnaire, Clinical COPD questionnaire, SF-12, COPD Assessment Tool, Chronic Respiratory questionnaire and a Chronic Heart Failure questionnaire. Similar to patient and caregiver studies, excluding the SF-12, all outcomes measures for HRQoL are illness specific. Details of outcome measures are included in the summary of studies table online. The pooled patient HRQoL studies that included caregivers and studies that did

not were not significantly different (P= 0.84). Statistical heterogeneity was evident across both groups of studies (caregivers not involved; I^2 = 62% and caregiver included; I^2 = 83%). A sensitivity analysis removing COPD studies did not yield any different interpretation of results (P=0.93) Statistical heterogeneity across both groups (caregivers not involved; I^2 =71% and caregiver included; I^2 = 88%). Figure demonstrating sensitivity analysis can be viewed online.

Figure 3 – Forest plot comparing caregiver included studies with studies not involving caregivers

2) Vote Counting

A number of included studies reported >1 HRQoL domains giving a total of 239 HRQoL intervention vs controls. The results of vote counting were consistent with the meta-analysis in that only seven (7%) intervention vs control comparisons showed statistical superiority (P<0.05) compared to control (see online supplementary file).

Impact on caregiver HRQoL of self-management interventions involving caregivers

Due to the small sample size (n=4) reporting caregiver HRQoL in the included studies we did not undertake a meta-analysis and instead report these findings narratively. These four studies reported caregiver HRQoL outcomes (Ågren, et al., 2015, Ågren, et al., 2012; Liljeroos, et al., 2015; Srisuk, et al., 2017) using either the SF-36 or SF-12. Partners at 12 months in the psychoeducational intervention group improved their HRQoL compared to control (Ågren, et al., 2015). The study with longest follow up; 24 months, which recorded caregiver outcomes (Liljeroos, et al., 2015) demonstrated that caregiver HRQoL scores were significantly reduced (indicating a deterioration) in physical functioning on the SF-36. A family-based education demonstrated no difference in caregiver HRQoL between intervention and control group after six months (Srisuk, et al., 2017). Caregiver HRQoL in this study was reported to be consistent with the general population. (Srisuk, et al., 2017).

DISCUSSION

In accord with aims of this study, our review demonstrated two key findings. First, the methodology of caregiver involvement in intervention delivery was poorly reported. Second, there was no evidence from meta-analysis of a gain in patient HRQoL in RCTs that involved caregivers in the delivery of self-management interventions for patients with HF and COPD. The pooled patient HRQoL in RCTs that included caregivers in intervention delivery compared with studies that did not include caregivers were not significantly different (P=0.84). However, these finding need to be interpreted cautiously in the context of the methodological constraints of this study i.e. small number of included trials; imperfect matching between the two groups of trials; and high levels of statistical heterogeneity within both groups of trials. We were not able to assess the impact of caregiver involvement in intervention delivery on caregiver HRQoL due to lack of data.

Our findings are consistent with Pillemer, Suitor and Wethington (2003), who concluded that interventions utilising broader theoretical evidence may have more successful outcomes and reduce the lack of clarity and inconsistent findings which occur in caregiver studies. They posit that intervention development should be aimed at dyads. Cho (2007) proposes a theoretical framework for the effect of caregivers on elderly care recipients. It concludes; the type of caregiver, nature of the relationship, whether caregiving is direct or indirect and the internal processes of the care recipient

(psychological, behavioural and physiological) are caregiver influences on elderly care recipient outcomes and should be considered in intervention development and delivery.

One example of comprehensive intervention development is the approach used in developing an evidence based self-management intervention for HF patients and their caregivers (Greaves, et al., 2016). Utilising intervention mapping and eliciting and synthesising information from a multitude of sources they produced the rehabilitation enablement in chronic heart failure intervention (REACH-HF). This intervention demonstrated a clinically significant improvement in disease specific HRQoL. (Dalal, et al., 2018).

The depth of caregiver engagement in studies is difficult to determine as the extent of caregiver involvement is not explicitly documented. The high level of heterogeneity across caregiver studies may reflect this. We know from research that caregivers have a complex array of needs when engaging in the role (Dionne-Odom, et al., 2017; Noonan, Wingham, & Taylor, 2018). The effects of involving caregivers in interventions are variable (Sörensen, Pinquart, & Duberstein, 2002). The type of intervention, the method of study and the caregiving context all need to be heeded when involving caregivers (Söresnsen, et al., 2002). Each of the studies included in this meta-analysis adhered to some but not all of these concepts. The two studies which demonstrated statistically significant outcomes in favour of caregiver involvement (Hasanpour-Dekhordi, et al., 2016; Srisuk, et al., 2017) are worth reflecting on when considering development of caregiver involved interventions. Both studies were conducted in middle income countries. Their utilisation of evidence in intervention development, multidisciplinary delivery and provision of multi-component materials to participants are all in line with the Medical Research Council guidelines for developing and evaluating complex interventions (Craig, et al., 2006). It is important to note that we cannot make assumptions due to the small number of studies.

Our indicative finding of no gain in patient HRQoL from caregiver involvement in intervention delivery is in contrast to the conclusions from systematic reviews which suggest caregivers should be involved intervention processes (Bryant, et al., 2016; Dionne-Odom, et al., 2017; McIlfatrick, et al., 2017; Noonan, et al., 2018). Zariksson and colleagues conducted interviews with caregivers of COPD patients two years after they participated in a one-off education session of a COPD self-management programme. Caregivers reported feelings of fear due to increased knowledge about the condition. They also reported feeling empowered, an increased sense of togetherness with the patient and greater understanding of the condition. The conclusion from this intervention is that inviting caregiver to one education session is not enough and that further strategies such as psycho-education are necessary (Zariksson, Theander, & Anderzén-Carlsson, 2013). Interviews from family members who were part of a palliative care intervention for HF patients revealed how participating in the intervention resulted in feeling less worried and less responsibility as the care was shared between them and the healthcare professionals. Caregivers did identify a lack of support for their own needs, concluding that interventions should also be targeted towards supporting caregivers, to maintain them in their caregiving role (Alvariza, Årestedt, Boman, & Brännström, 2018).

Interpreting these findings should be considered in the context of a number of limitations of this study. First, this review identified only a small number of studies that included both caregivers in the delivery of self-management intervention. Of these, only seven reported their outcomes so they could be included for meta-analysis. Nissen, Madsen and Zwisler (2008) reported similar findings. Their literature review examined health interventions targeted at relatives of HF patients. They report health service intervention studies examining caregiver and patient are few in quantity and poor in quality. As a result they were unable to determine the overall evidence for the effectiveness of the conducted interventions. Similar conclusions were reached from a review of research output in COPD

focusing on burden and unmet need of caregivers (Mansfield, et al., 2016). They emphasised the need for more rigorous research in this area. Second, formally involving caregivers in interventions for patients with HF and COPD is a developing area of practice and process of caregiver engagement remains poorly reported. Descriptions of what constituted caregiver involvement in interventions differed between studies. It is important to acknowledge that caregivers may have been involved to some degree even when not specifically reported. However, a key aim of this review was examining the impact of explicitly involving caregivers in the intervention process. Therefore, this does make a direct comparison of studies involving versus not involving caregivers difficult. A previous systematic review examining caregiver involvement in COPD patients (Cruz, et al., 2017) was also limited by the lack of clarity on how caregivers were involved in interventions. Third, the matching criteria has some potential limitations. While we set out to compare treatment effect it was difficult due to the volume of patient only studies and the lack of caregiver included studies. We matched on four variables (Diagnosis, publication year, geographic location and exercise as a component of the intervention), however other variables could have been used for matching (e.g. severity of the illness, sample size and intervention duration). However, the four selected criteria were deemed to be free from bias and the most homogenous across studies facilitating a quasi-randomised sampling strategy. Fourth, this review examined only patient outcomes in terms of HRQoL. It did not examine patient hospitalisations or mortality or caregiver burden which may have produced different findings. However, given the lack of evidence identified by this review, we believe it is unlikely that RCTs reporting such outcomes are available. Much of the literature in this area of caregiver involvement in HF and COPD is commonly qualitative in its approach and RCT's are limited. As identified by Hartman, et al. (2010) and Srisuk, Cameron, Ski and Thompson (2016), there is a greater need for RCT's which examine patient and caregiver outcomes to determine the value of dyadic interventions in chronic illness.

CONCLUSION

This review demonstrates that RCT's examining the impact of caregivers in interventions are limited. Additionally, those studies which have examined caregiver involvement are limited in; describing the methodology of caregiver involvement, recording of caregiver outcomes and their reporting of theoretical underpinnings of the intervention development. Self-management interventions are complex and should not be taken as a one size fits all approach (Warsi, et al., 2004). A key factor necessary in self-management is to facilitate the development of social support (Rotherham-Borus, et al., 2012). This review set out to compare the impact of involving caregivers in interventions for those with HF and COPD versus interventions not involving caregivers. Within the methodological constraints of this study (i.e. relatively small number of included RCTs, imperfect matching of RCTs, and high levels of statistical heterogeneity), our results provide indicative evidence that involving caregivers in self-management interventions do not appear to further improve the HRQoL of HF or COPD patients. Greater reporting of the methodology of caregiver involvement and understanding the complexity of self-management interventions and the intricacy of the patient caregiver dyad will facilitate the development of more robust evidence-based interventions for patients and caregivers in HF or COPD interventions. This review demonstrates the need for further empirical research involving caregivers in interventions with this population and documenting the outcomes of patients and caregiver HRQoL.

Implications for clinical practice

This systematic review demonstrates that self-management interventions can have positive impact on the HRQoL of HF and COPD patients. Clinicians must reflect upon how they are currently involving caregivers in interventions and whether that engagement is meaningful. Meaningful engagement of caregivers may yield greater intervention success.

Implications for future research

This systematic review highlights the need for further research into the involvement of caregivers in the design and development of self-management interventions for chronic illness. When reporting studies involving caregivers, a greater depth of information needs to be provided on what constitutes caregiver involvement and what caregiver outcomes are in addition to patient outcomes. Future studies need to be more robust with greater emphasis on reporting data and managing blinding of participants and personnel. Addressing these issues may assist to produce a taxonomy of the type of caregiver involvement in self-management interventions for HF and COPD patients.

ANONYMISED CONFLICT OF INTEREST STATEMENT

No conflict of interest

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